REPORT 25

SWEEP

SOIL AND WATER

ENVIRONMENTAL

ENHANCEMENT PROGRAM

PAMPA

PROGRAMME D'AMÉLIORATION

DU MILIEU PÉDOLOGIQUE

ET AQUATIQUE

Canada

Ontario

SWEEP

is a $30 million federal-provincial agreement, announced May 8, 1986, designed to improve soil and water quality in southwestern Ontario over the next five years.

PURPOSES

There are two interrelated purposes to the program; first, to reduce phosphorus loadings in the Lake Erie basin from cropland run-off; and second, to improve the productivity of southwestern Ontario agriculture by reducing or arresting soil erosion that contributes to water pollution.

BACKGROUND

The Canada-U.S. Great Lakes Water Quality Agreement called for phosphorus reductions in the Lake Erie basin of 2000 tonnes per year. SWEEP is part of the Canadian agreement, calling for reductions of 300 tonnes per year — 200 from croplands and 100 from industrial and municipal sources.

PAMPA

est une entente fédérale-provinciale de 30 millions de dollars, annoncée le 8 mai 1986, et destinée à améliorer la qualité du sol et de l'eau dans le Sud-ouest de l'Ontario.

SES BUTS

Les deux buts de PAMPA sont: en premier lieu de réduire de 200 tonnes par an d'ici 1990 le déversement dans le lac Erie de phosphore provenant des terres agricoles, et de maintenir ou d'accroître la productivité agricole du Sud-ouest de l'Ontario, en réduisant ou en empêchant l'érosion et la dégradation du sol.

SES GRANDES LIGNES

L'entente entre le Canada et les États-unis sur la qualité de l'eau des Grands Lacs prévoyait de réduire de 2 000 tonnes par an la pollution due au phosphore dans le bassin du lac Erie. PAMPA fait partie de cette entente qui réduira cette pollution de 300 tonnes par an — 200 tonnes provenant des terres agricoles et 100 tonnes provenant de sources industrielles et municipales.

TECHNOLOGY EVALUATION AND DEVELOPMENT SUB-PROGRAM

THE DEVELOPMENT AND TESTING OF A DRY FERTILIZER PLACEMENT MACHINE

FINAL REPORT

August, 1991

Prepared by: ALBIN-TILL-TECH JOINT VENTURE,
St. Thomas, Ontario

Under the Direction of: ECOLOGICAL SERVICES FOR PLANNING LIMITED,
Guelph, Ontario - Subprogram Manager For TED

On Behalf of: AGRICULTURE CANADA
RESEARCH STATION,
HARROW, ONTARIO N0R 1G0

Disclaimer: The views contained herein do not necessarily reflect the views of the Government of Canada or the SWEEP Management Committee.

Recycled Paper

Papier recyclé

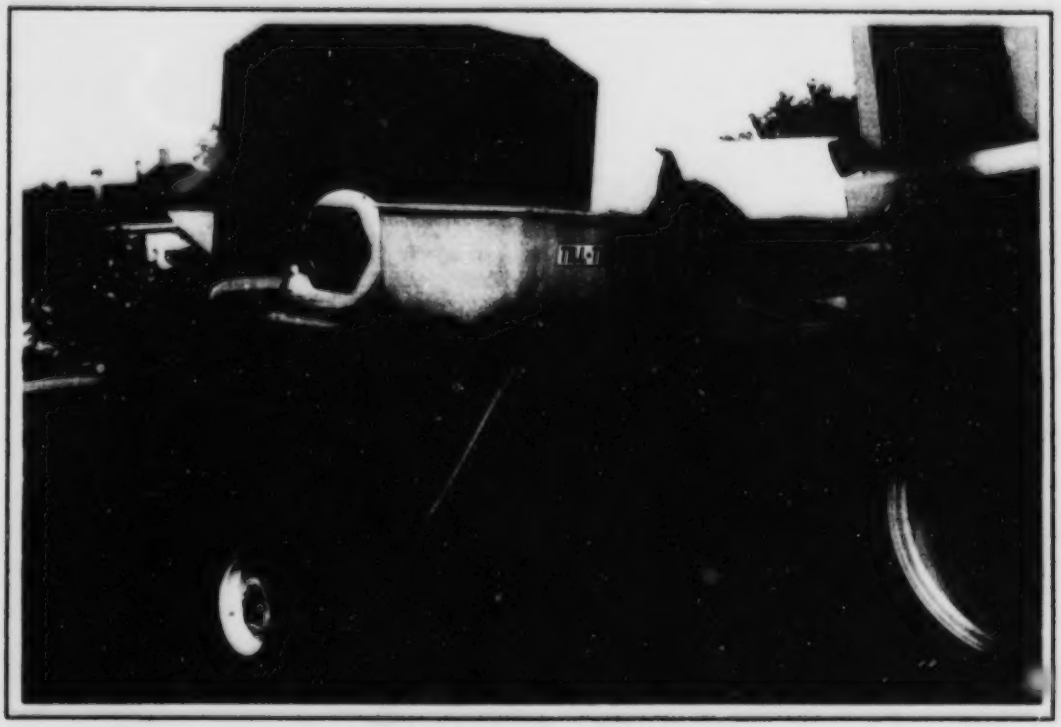
100-05304/

The Development & Testing

of a

Dry Fertilizer Placement Machine

1989 - 1990



Fertilizer Zone-tiller

A

Technology Evaluation and Development

Project

under

S.W.E.E.P

Doug Albin
Till-Tech Systems Limited

June 1991

EXECUTIVE SUMMARY

The objective of this project was to develop a machine which would provide farmers practising conservation tillage with the means to apply dry form nitrogen sources (ie. urea and/or ammonium nitrate). Before the project began, the standard nitrogen source used in reduced tillage systems was liquid 28% N which was applied by an applicator developed to inject the material into the soil.

From an environmental perspective, the benefits of the prototype machine (hereafter referred to as fertilizer zone-tiller) are seen as follows:

* the environmental risks associated with storage are lower with dry forms (urea and ammonium nitrate) than with liquid 28% N or anhydrous

* the fertilizer zone-tiller works effectively in no-till applications and in varied soil types (tested in sandy loam and clay loam soils). The coulter design cut previous-crop residue for accurate fertilizer placement while leaving trash between the rows for continued soil protection from wind and water erosion.

* the fertilizer zone-tiller can be pulled in tandem with the planter thus reducing: 1) fuel consumption and, 2) field passes (risk of soil compaction is less)

The criteria for judging the success of this project were established as follows:

If corn fertilized using the fertilizer zone-tiller performed[1] at least as well as corn fertilized with the liquid 28% N applicator,

then, the fertilizer zone-tiller is a feasible fertilizer placement machine.

If comparable or better results can be achieved using dry nitrogen fertilizers (vs. 28% N), then, conventional farmers who favour their use might be more inclined to convert to soil conservation cropping techniques.

---

[1] Evaluation parameters - yield, biomass, height and nitrogen uptake

To establish whether the fertilizer zone-tiller has merit, it were tested over two years with two plots on a sandy loam site (1989, 1990) and one plot at a clay loam location (1990). While corn at the clay loam location did not show a response to nitrogen, good data were collected over two years at the sandy loam site. Results from the latter site are summarized below:

Year 1 - **urea vs. liquid 28% N**

* liquid 28% N showed a slight advantage over urea though the yield difference was not statistically significant

Year 2 - **dry fertilizer (20% ammonium nitrate + 80% urea) vs. liquid 28% N**

* the dry fertilizer combination outperformed both liquid 28% N treatments (with and without coultering) by a significant 747 kg ha_{-1} and 1158 kg ha_{-1} respectively

In year 2, ammonium nitrate was applied to all dry fertilizer treatments at time of planting. The timing of urea application was varied according to the original testing procedure.
Starter fertilizer comprised of phosphorus and potassium was applied to plots based on soil test recommendations taken each year.

CONCLUSION

With the fertilizer zone-tiller performing *at least as well* as the liquid 28% N applicator, the data clearly suggests that it is a viable alternative in conservation tillage systems.

TABLE OF CONTENTS

Section		Page
OBJECTIVE		1
METHOD - YEAR 1		2
	1. Testing Procedure	2
	2. Planting	5
	3. Side-dressing	5
	4. Weed Control	6
	5. Harvesting	6
	6. Other Observations	7
RESULTS - YEAR 1		7
METHOD - YEAR 2		12
	1. Testing Procedure	12
	2. Planting	17
	3. Side-dressing	18
	4. Weed Control	18
	5. Harvesting	18
	6. Other Observations	19
RESULTS - YEAR 2		19
ECONOMIC IMPLICATIONS		30
EQUIPMENT DEVELOPMENT & MODIFICATIONS		31
	1. Operational Performance - Year 1	31
	2. Problems and Solutions	31
	3. Operational Performance - Year 2	32
	4. Equipment Design and Specifications	33
	5. Pictures	34
	6. Enhancements Needed for Commercial Use	35
SUMMARY		36
PROJECT PUBLICITY		38

TABLE OF CONTENTS

LIST OF FIGURES

		Page
Figure 1	- 28% N vs. Urea (1989)	4
Figure 2	- 28% N vs. Urea (1990)	14
Figure 3	- Urea Placement Experiment (1990)	16

LIST OF TABLES

Table 1	- Ave. crop measurements (1989)	8
Table 2	- Summary of yield measurements (1989)	9
Table 3	- Measurements at time of planting (1989)	10
Table 4	- Measurements at 6-leaf stage (1989)	11
Table 5	- Ave. crop measurements - Albin (1990)	20
Table 6	- Yield - time of planting - Albin (1990)	22
Table 7	- Crop growth parameters - Albin (1990)	23
Table 8	- Ave. crop measurements - Prong (1990)	25
Table 9	- Yield - time of planting - Prong (1990)	26
Table 10	- Ave. grain response - Prong (1990)	27
Table 11	- Yield response to urea placement	29
Table 12	- Overall yield summary	36

APPENDICES

I	Albin Site - 1990
II	Prong Site - 1990
III	Prong Site - 1990
VI	Albin Site - 1989
V	Albin Site 1989-1990
VI	Coefficients for Statistical Analysis

OBJECTIVE

As previously stated, the objective of this project was to develop a dry fertilizer placement machine for use in no-till or reduced tillage cropping systems. Since the liquid 28% N applicator is viewed as the standard nitrogen fertilizer placement method in conservation tillage systems, it was used as the control to test our prototype. While the fertilizer zone-tiller is judged to be feasible if it at least matches results achieved by this standard, other factors should be considered when choosing between nitrogen fertilizer sources.

In addition to the environmental advantages of the proposed technology (highlighted above), other benefits of using dry fertilizer combinations vs. liquid 28% N and/or anhydrous ammonia are:

1. Dry fertilizer is easier to store and handle than nitrogen in the 28% or anhydrous form.

2. A lower volume of fertilizer is transported when N in dry forms are used vs. 28% N. This means less fuel to apply comparable amounts of actual nitrogen.

3. At times, there is a cost advantage to using urea vs. 28%.

4. More farmers have ready access to urea than to liquid 28% N.

5. Urea and ammonium nitrate fertilizers are safer products to handle than anhydrous ammonia.

The fertilizer zone-tiller itself will also provide utility in the following ways:

1. A spring pass by the machine prior to planting could result in faster drying and warming of the soil such that planting could be undertaken at an earlier date.

2. To reduce field passes, the machine could be pulled in tandem with the planter.

3. The machine, with adjustments for fertilizer placement, can be used as a side-dressing unit.

4. Machine design accommodates split applications (ie. banding on both sides of the crop row) as opposed to placement in one large dose between the rows. This, we feel, will result in more effective fertilizer use.

6. The machine is suitable to varied soil types and conditions.

7. The lift-assist wheels, in addition to supporting the weight of the machine and fertilizer, provide a safety benefit (ie. not as much weight on the tongue).

In summary, the action of the proposed machine is compatible with the objectives of a reduced tillage cropping system -- to reduce soil erosion and soil compaction with a view to maintaining the agricultural productivity of the soil in the long term.

METHOD - YEAR 1

1. TESTING PROCEDURE - 28% N vs. Urea applicator 1989 study

The method designed was to:

i) Compare the grain corn yield response to applied fertilizer N using a currently recommended method (28% N side-banded) and the new equipment.

ii) Compare the two fertilizer systems at two different times of fertilizer application, seeding and 6-leaf stage.

The following treatments were performed on a 2 hectare sandy loam plot (Albin). While another plot on a clay loam site was planned, wet weather prevented planting in a timely manner.

2	Methods	-	28 % applicator vs. fertilizer zone-tiller
x			
2	Rates	-	application of 56 kg ha^{-1} of N vs. application of recommended rate
x			
2	Timings	-	N applied at planting vs. N applied at 4 - 6 leaf stage
x			
3	Replications	-	each replication was approximately 100 meters long x 60 meters wide (about 78, 30" corn rows)
=	24 plots	-	with headlands between the 3 replications, the total test area covered approximately 2 hectares

The experiment was set up as a randomized complete block with three replications. In addition to this design, the treatments were separated by an equal sized treatment with 0 kg ha^{-1} fertilizer N to use as a covariate in case of uneven site variability, which is common when using large plots. The large size of each treatment replication was to ensure adequate plot length for proper performance of the field equipment being tested. The liquid 28% N fertilizer was applied with the Department of Land Resource Science (University of Guelph) 28% applicator.

A diagram of the plot design is shown in Figure 1. The coding for Figure 1 is:

L = Liquid 28% N sidedress method
U = Urea zone till application system
50 = target 50 kg ha^{-1} fertilizer N-rate (actual = 56)
150 = target 150 kg ha^{-1} fertilizer N-rate (actual = 156)
1 = application at time of seeding
2 = application at 6-leaf stage

The urea application system has a set of twin coulters, which along with the fertilizer openers passively till an area approximately 25 cm wide around the seed row. In order to test the fertilizer placement system separately from the seed zone tillage effect, the plots which had the 28% N applied were first subjected to the zone-till fertilizer placement machine with the fertilizer supply shut off. Thus all treatments, including the check plots had intensive coulter tillage in the seed row area. Thus, the experiment is testing the placement and type of fertilizer (dry urea versus 28% N).

The land chosen was known to be low in nitrogen reserves and the actual nitrogen response shown in test results confirmed this. Soil tests obtained by Mr. Albin prior to planting indicated that there were adequate soil reserves of both phosphorus and potassium. Accordingly, no starter fertilizer was applied.

Figure 1

28% N vs. UREA
Experiment - 1989

Block I	Block II	Block III
C 1	C 1	C 1
U 50-2	U 50-2	U 150-1
C 2	C 2	C 2
L 150-1	U 150-2	L 50-1
C 3	C 3	C 3
U 150-1	L 50-1	L 150-2
C 4	C 4	C 4
L 150-2	L 50-2	U 150-2
C 5	C 5	C 5
L 50-2	U 50-1	U 50-1
C 6	C 6	C 6
U 50-1	L 150-1	U 50-2
C 7	C 7	C 7
U 150-2	U 150-1	L 50-2
C 8	C 8	C 8
L 50-1	L 150-2	L 150-1
C 9	C 9	C 9

TYPE

U = Urea

L = Liq. 28% N

C = Check

DOSE

50 = 50 Kg/Ha

150 = 150 Kg/Ha

TIME

1 = Planting

2 = 6 Leaf

2. PLANTING

On May 18th, 1989 the test plot was planted at a target population of 66,720 plants per ha (27000 plants per acre) using the Pioneer 3902 corn variety. There were two machinery passes over the plot (three passes where the 28% fertilizer was applied):

1) the fertilizer zone-tiller was pulled through the entire plot and alternately applied fertilizer with nitrogen rates of zero, 56 and 156 kg ha^{-1}. The urea was placed in a split application, 11 cm from the seed, on both sides.

2) corn was then planted in the zone that had been prepared by the zone-till machine. The previous year's corn rows were used as markers for both passes. In the designated areas, fertilizer was applied by the 28% applicator some 13 cm from the seed, on one side of the row, and at the rates stated above.

Planting Checks

- the planter was inspected for mechanical problems prior to planting
- row spot checks were undertaken to ensure proper population and seed placement

Calibration

- during calibration of the prototype, checks were done to ensure that the fertilizer was split evenly on both sides of the row
- the liquid 28% N applicator was calibrated by a technician at the University of Guelph. Prior to usage, it was checked to ensure it was in good working order.

3. SIDE-DRESSING

Once the crop had emerged, yield and crop growth monitoring locations were selected within each of the treatment plots. Yield subplots consisted of two 6 m lengths of corn row from the inner two rows of the treatment. All data and harvested samples were taken from these sub-plots to ensure reliable results.

On June 26th, 1989 fertilizer was side-dressed in the specified treatments and at the rates stated above. The urea was placed in a split application, 25 cm from the plant, on both sides, by the prototype. Liquid 28% N was placed between the rows at the mid-point (approximately 45 cm from the plant).

Fertilizer Flow

- during fertilization at both planting and side-dressing time, there were no problems with fertilizer flow

  Note: During later field testing however, humidity resulted in the fertilizer gumming in the splitting device. As discussed later in the report, this problem was alleviated with the installation of an air delivery system.

A qualified field technician was present on both dates to ensure the plot was worked/planted according to the plot design prepared by Dr. Kachanoski, project Technical Advisor.

4. WEED CONTROL

- a visual inspection of the field indicated the weed control program to be adequate

Timing	Treatment
fall '88	Round-up @ 2.5 litre/ha + 2,4-D Ester @ 2.5 litre/ha + Surfactant
May 13/89	Dual @ 2.5 litre/ha + 2,4-D Amine @ 1 litre/ha + Surfactant
June 3/89	Banvil @ .62 litre/ha

Note: some mechanical weed control occurred when the fertilizer was side-dressed in late June

5. HARVESTING

The corn was hand harvested and moisture content determined to express yield on a 15.5% (wt) moisture content basis. Plant samples were taken at the 6-leaf stage (June 18) for biomass and phosphorus measurement to determine if adequate levels were available[1]. Total plant samples were taken after maturity to determine total biomass production as well as %N and total N uptake. Plant populations and heights were examined in detail on July 15 (10-11 leaf stage) by selecting 10 sub-plots at random within each treatment and averaging the measurements. A summary of the observations is given in Appendix IV.

---

[1] The bicarbonate extractable (OMAF test) for phosphorus averaged 29.0 ppm (ten samples). Based on OMAF Publication # 296, this represents an acceptable phosphorus level and thus it was not necessary to supplement with fertilizer.

5. HARVESTING (cont'd)

- these marked sub-plots were hand-harvested on or about Oct. 8th by qualified field technicians
- the remaining crop was combine harvested later that month and yielded the equivalent of 3700 kg/ha (58.9 bu./acre).

6. OTHER OBSERVATIONS

Aside from the test data summarized in tables and appendices, the following visual observations were made.

Some plant population skips were noted in all treatments (not all replications). This might be explained by planter malfunctions or germination problems; however, since skips were not observed on the rest of the field, where the same planter and corn hybrid had been used, we are unsure what the cause of the problem actually was.

Compared to the rest of the field, the plot was less vigorous. While the field was planted about 10 days earlier, it also benefitted from the application of a starter fertilizer comprised of 33.4 kg ha^{-1} of actual N in the form of ammonium nitrate (aeroprills).

RESULTS - YEAR 1

1989 Study

Agronomic testing revealed two relationships of note:

a) tests comparing urea and 28% nitrogen sources showed a slight yield advantage to 28%, and,

b) in the timing comparison, higher yields were achieved when the fertilizer was applied at planting rather than at the 6 leaf stage of plant growth.

A summary of the data collected and the associated analysis of variance for the 1989 comparison of 28% N and the Urea zone-till applicator is given in Appendix IV. A summary of the average crop measurements for the Albin 1989 site as a function of applied N fertilizer is given in Table 1. As indicated there was a significant increase in the yield at the 56 and 156 kg N ha^{-1} application rates, over the check (0 kg N ha^{-1}) plots. However, the increase in yield from the 56 to 156 kg N ha^{-1} rates was not significant.

Similar trends were found with the other plant parameters (Table 1.), with significant increases measured in the 56 and 156 kg N ha^{-1} treatments over the check. Total N uptake increased by 90 kg ha^{-1} and 121 kg ha^{-1} for the low and high rate of fertilizer added respectively. Plant population was not significantly affected by the treatments.

Table 1. Average crop measurements for the 1989 Albin site as a function of applied N fertilizer.

Plant Measurement	Applied Fertilizer N (kg N ha^{-1}) 0	56	156
Yield (bu/ac)	60.5[a]	88.7[b]	91.6[b]
Full Biomass (tonne/ha)	8.3	12.4	13.4
Biomass N (kg N /ha)	105	195	226
Tissue N (%)	1.25	1.54	1.68
Biomass (g/pl)	100	153	160
Population (pl/m)	7.6	7.4	7.6

Values in the same row with different letters are significantly different at the 0.05 probability level.

The analysis of variance[1] for treatment effects on yield is given in Appendix IV. The major effect is time of application (significant at only 0.11 level). A summary of the yield data is given in Table 2. The Duncan-Wallis multiple range test for difference in mean values indicated that the 28% N at time of planting was significantly greater (Prob ≤ 0.05) than Urea at time of sidedress (averaged across N rates). Also the overall average for application at planting time was significantly greater (Prob ≤ 0.05) than application at the 6 leaf stage (averaged across application times).

[1] Both Type I and Type II analyses were calculated in all Analyses of Variance as a means to check the integrity of each analysis. In Type I, the statistical hypothesis assumes all treatments will be different and those treatments that are comparable are highlighted. In Type II, the hypothesis assumes all treatment results will be similar and accordingly, those that are different are highlighted.

Table 2. Summary of yield measurements for Albin 1989.

Fertilizer Application Method	Corn Grain Yield (bu ac^{-1})					
	56 kg N ha^{-1} applied			156 kg N ha^{-1} applied		
	Planting	6 leaf	Avg	Planting	6 leaf	Avg
28% sidedress	93.1	86.4	89.7	102.2	88.1	95.1
Urea zone-till	94.2	80.8	87.5	89.2	86.5	87.9
Average	93.6	83.6	88.6	95.7	87.2	91.5

A summary of the major crop characteristics for the different treatments at the planting and 6 leaf application times is given in Table 3 and Table 4 respectively. Analysis of variance for the different crop characteristics independently generally showed little significant effect of the fertilizer application system.

Table 3. Average crop measurements for application of fertilizer N at time of planting. Albin, 1989

Plant Measurement	Application at Planting					
	56 kg N/ha			156 kg N/ha		
	28%	Urea	delt(%)*	28%	Urea	delt(%)*
Yield (bu/ac)	93.1	94.2	1.0	102.2	89.2	-12.7
Harvested cob(C/m)	6.6	6.4	-3.0	6.6	6.2	-6.1
Popul° 10L (pl/m)	7.7	7.5	-2.6	7.7	7.4	-3.9
Height 10L (m)	1.0	0.9	-10.0	1.0	0.9	-10.0
Biomass 6L (g/pl)	3.5	2.8	-20.0	3.2	3.1	-3.0
Tissue N milk(%)	1.72	1.48	-14.0	1.78	1.63	-8.4
Biomass N(kg N/ha)	219	198	-9.5	264	207	-21.5

* (Urea - 28%)/28% * 100

However, over all measurements, the data clearly showed a consistently better crop response for the 28% N systems over the Urea zone-till system for the application at planting (Table 3). All parameters were higher in the 28% N system including height, biomass, total N uptake and harvestable cobs. The crop measurements for the 6 leaf application time (Table 4) are not very conclusive, with the Urea system favoured at the low rate (56 kg N ha^{-1}) and the 28% N system favoured at the higher rate (156 kg N ha^{-1}). The data suggest that the urea zone-till system did adversely affect crop growth compared to the 28% N system, but the yield was not affected enough to be statistically significant.

Table 4. Average crop measurements for application of fertilizer N at the 6-leaf stage. Albin, 1989

Plant Measurement	Application at Planting					
	56 kg N ha^{-1}			156 kg N ha^{-1}		
	28%	Urea	delt(%)*	28%	Urea	delt(%)*
Yield (bu/ac)	82.2	85.1	+3.4	94.4	88.5	-6.2
Harvested cob(C/m)	6.9	6.2	-10.0	6.6	6.1	-7.5
Popul" 10L (pl/m)	6.9	7.4	+7.2	7.8	7.7	-1.2
Height 10L (m)	0.8	0.9	+12.5	0.9	0.8	-11.1
Biomass 6L (g/pl)	3.1	3.3	+6.5	3.5	3.4	-2.9
Tissue N milk(%)	1.42	1.53	+7.8	1.7	1.62	-4.7
Tot. Pl.N(kg N/ha)	152	210	+38.1	225	209	-7.1

* (Urea - 28%)/28% * 100

In summary, the Urea zone-till system was having a slight negative effect on corn grain yield and general crop growth characteristics. Secondly, applying the fertilizer at time of planting increased yields relative to application at the 6 leaf stage. It was decided that the 1990 Urea treatment would include 10% of its fertilizer N as a starter to try and offset the slight negative effects measured in 1989.

In consideration of these results testing in Year 2 was modified with a view to determining:

a) whether toxicity and/or volatilization could explain the lower yields in the urea treatments, and secondly,

   i) maybe the urea was too close to the root zone of the plant such that during the hydrolysis process, toxicity occurred
   ii) given that the urea was placed roughly 5 cm deep while the liquid 28% was injected about 13 cm below the soil surface, more volatilization may have occurred with the urea fertilizer

b) whether, a small amount of nitrogen, in the form of ammonium nitrate (aeroprills), applied at planting on all urea treatments, would result in yields similar to those achieved on the liquid 28% N treatments

In addition, another method was added to the original test to determine whether there is a yield response to coultering. This test was proposed in response to concerns by some reduced-tillage practitioners that planting is usually later than in conventionally-cropped fields because undisturbed soil takes longer to warm and dry. The fertilizer zone-tiller, while applying starter fertilizer, could be used to prepare a seed zone in fields that are too wet or cold to plant in. Particularly in a wet year, this zone tillage could be an important factor in getting the crop planted in a timely manner.

METHOD - YEAR 2

1. TESTING PROCEDURE - 28% N vs. Urea applicator 1990 study

The method described for Year 1 was modified to find out whether:

1) a dry fertilizer combination, including 20% ammonium nitrate would achieve results comparable to those from liquid 28%

   Perhaps urea does not provide nitrogen in a form usable by the plant until some time has elapsed after application. Conversely, ammonium nitrate may provide readily available nitrogen, soon after application. Therefore, in order to meet the nitrogen needs of the seedling, an early application of ammonium nitrate might enhance plant vigour and growth.

2) there is a yield response to coultering

   The original experiment was designed to compare nitrogen sources and thus all treatments were coultered. However, from a practical point of view, the question to be answered is whether the dry fertilizer placement machine compares favourably with 28% N knifed into the soil when no-till planting (a popular method currently used by a majority of farmers practising soil conservation methods). In other words, there may, in fact, be a yield response to zone tillage at or prior to planting.

Year 2 testing (dry vs. liquid N sources) is summarized below:

3 **Methods**	-	dry fertilizer placed by prototype and planter (ie. combination urea and aeroprills) vs. liquid 28% injected into prepared zone
X		vs. liquid 28% and slot planting
2 **Rates**	-	application of 50 kg ha^{-1} N
X		vs. application of 150 kg ha^{-1} N
2 **Timings**	-	N (urea vs. 28%) applied at planting
X		vs. N (urea vs. 28%) applied at 4 - 6 leaf stage
3 **Replications**	-	each replication was approximately 100 meters long x 90 meters wide (about 118, 30" corn rows)
= 36 **plots**	-	with headlands between the 3 replications, the total test area covered approximately 3 hectares

Note: On all dry fertilizer treatments, the ammonium nitrate was applied with starter fertilizer at planting.

At each of the two sites (Albin's and Prong's) the experiments were set up as randomized complete blocks with a check treatment as an added covariate, with three replications (blocks). Each of the three blocks contained three fertilizer application systems (28% N side banded "L", 28% N side banded plus coultered row area "LC" or "C" in the statistical appendix, and Urea side banded plus coultered row "U"). Each of the application systems were used to apply N fertilizer at two rates (50 kg N ha^{-1}, and 150 kg N ha^{-1}), and each rate at two application times (seeding, and 4-6 leaf stage). This gave a total of 3 x 2 x 2 x 3 reps = 36 treatments. In addition to this design, each of the treatments were separated by an equal sized treatment with 0 kg N ha^{-1} (covariate check). This gave a total of 72 individual plots, each 3.6 m wide (4 corn rows at 0.9 m row spacing) by approximately 50 m long. The large size of each treatment replication was to ensure adequate plot length for proper performance of the field equipment being tested.

The check treatments (0 kg N ha^{-1}) were coultered once prior to a pass with the dry fertilizer placement machine.

A diagram of the field plot design is given in Figure 2.

Figure 2

28% N vs. UREA
Experiment - 1990

Block I	Block II	Block III
C 1	C 1	C 1
U 50-2	LC 150-2	U 150-1
C 2	C 2	C 2
L 150-1	LC 150-1	L 50-1
C 3	C 3	C 3
LC 50-2	U 50-2	L 150-2
C 4	C 4	C 4
U 150-1	U 150-2	LC 50-1
C 5	C 5	C 5
L 150-2	L 50-1	U 150-2
C 6	C 6	C 6
LC 50-1	L 50-2	LC 150-2
C 7	C 7	C 7
LC 150-2	U 50-1	U 50-1
C 8	C 8	C 8
L 50-2	LC 50-1	LC 50-2
C 9	C 9	C 9
U 50-1	L 150-1	LC 150-1
C 10	C 10	C 10
U 150-2	LC 50-2	U 50-2
C 11	C 11	C 11
L 50-1	U 150-1	L 50-2
C 12	C 12	C 12
LC 150-1	L 150-2	L 150-1

TYPE

U = Urea
LC = Coultered 28% N
L = Liq. 28% N
C = Check

DOSE

50 = 50 Kg/Ha
150 = 150 Kg/Ha

TIME

1 = Planting
2 = 6 Leaf

Urea Placement Experiment, 1990

Possible explanations for the inferior response to urea vs. liquid 28% N are:

i) The urea was too close to the root zone of the plant such that during the hydrolysis process, toxicity occurred.

ii) Given that the urea was placed roughly 5 cm deep while the liquid 28% was injected about 13 cm below the soil surface, there is the possibility that there was more volatilization with the urea fertilizer.

Accordingly, a separate experiment was conducted on the clay loam site (Prong) to test whether the placement of urea affected its performance. Treatments are outlined below.

Urea Placement Plot

2	**Methods**	-	urea placed 5 cm deep vs. 15 cm deep
X			
4	**Widths**	-	urea banded on both sides of the seed at 10 cm, 15 cm and 25 cm at planting
			vs.
X			urea banded on both sides of the seed at 25 cm, at the 4-6 leaf stage
3	**Replications**	-	each replication was approximately 100 meters long x 60 meters wide (about 78, 30" corn rows)
=	**24 plots**	-	with headlands between the 3 replications, the total test area covered approximately 2 hectares

The urea placement experiment was set-up at one site (Prong farm) as a randomized complete block with three replications. A diagram of the field plot is given in Figure 3.

Figure 3

UREA Placement
Experiment - 1990

Block I	Block II	Block III
C 1 2-6-P C 2 6-10-P C 3 6-4-P C 4 6-10-S C 5 6-6-P C 6 2-4-P C 7 2-10-S C 8 2-10-P	C 1 2-10-P C 2 6-4-P C 3 6-10-S C 4 2-10-S C 5 2-4-P C 6 2-6-P C 7 6-6-P C 8 6-10-P	C 1 2-4-P C 2 2-10-S C 3 6-10-P C 4 6-6-P C 5 2-6-P C 6 2-10-P C 7 6-10-S C 8 6-4-P

Depth	Distance to row	Time of applic.
2 = 5 cm	4 = 10 cm	P = Planting
6 = 15 cm	6 = 15 cm	S = Sidedress
	10 = 25 cm	

2. PLANTING

Dry Fertilizer vs. 28% Experiment

- urea was placed in treatments at a depth of 7.5 cm and was a split application 13 cm on both sides of the seed
- the dry fertilizer treatments also had 20% of the total N applied (5 x 5 cm) as NH_4NO_3 at time of planting along with the starter fertilizer
- ammonium nitrate and starter fertilizer was applied via the fertilizer boxes on the planter
- 28% N was knifed in (14 cm depth) 13 cm on one side of the seed
- the corn was planted 4 cm deep
- the same planter was used on all plots

ALBIN (sandy loam)

- planting was concluded on May 11th at a target population of 67,900 plants ha^{-1}.
- corn (Pioneer 3790) was sown
- a starter fertilizer comprised of 27 kg ha^{-1} phosphorus and potassium was applied to the plot as recommended by soil tests

PRONG (clay loam)

- in an effort to get the plot planted prior to June 1st, the seed was sown in wetter conditions than one would normally plant in; press wheels weren't closing the gap really well
- based on fertilizer tests, 30 kg ha^{-1} of actual phosphorus and potassium were applied as a starter fertilizer with the ammonium nitrate
- planted to corn (Pioneer 3790) on May 25 at a target population of 67,900 plants per hectare

Urea Placement Plot

(PRONG - clay loam)

- site was planted at the same time as the other experiment at the Prong site, and similar measurements were taken to monitor the site
- plot was coultered once with the fertilizer zone-tiller to promote soil drying
- close to 150 kg N ha^{-1} of N in urea form was applied according to the depths and widths stated above
- no aeroprills were applied with the planter

** **Note:** While we had hoped to band the fertilizer at a 15 cm depth, due to the blade size, placement was limited to the 10 cm level.
Furthermore, fertilizer aimed at 5 cm was not banded there, but rather was incorporated in the top 5 cm of soil.

3. SIDE-DRESSING

Urea vs. 28% Experiment

- urea was placed 7.5 cm deep and 25 cm from plant on both sides in a split application
- 28% was placed 14 cm deep and in one dose mid-row (about 45 cm from plant)

ALBIN - side-dressed on June 26 according to methods described

PRONG - side-dressed on June 28/July 7 according to the methods described above

4. WEED CONTROL

Timing	Treatment
ALBIN	
herbicides were applied one week after planting	Dual @ 1.0 litre/acre Lorox @ .35 litre/acre Atrazine @ .90 litre/acre

Note: some mechanical weed control occurred when fertilizer was side-dressed in late June

Timing	Treatment
PRONG	
early Apr.	2,4-D Ester .75 litre/acre
May 18	Roundup @ 1.0 litre/acre
June 15	Basogram @ 1.0 litre/acre spot spraying with Marxman at 1.8 l/acre rate
July 1	cultivated

(Observed that Basogram got smaller weeds but, where weed plants were more advanced, eradication did not occur. Therefore spot spraying was needed.)

5. HARVESTING

Once the corn had emerged, two 6m lengths of corn, with uniform plant populations, were selected from two adjacent rows within each replication. All data and hand-harvested samples were taken from these sub-plots by qualified field technicians.

The corn was hand harvested and moisture content determined to express yield on a 15.5% (wt) moisture content basis. Plant samples were taken at the 6 leaf stage. Total plant samples were taken after maturity to determine total biomass production as well as %N and total N uptake. Plant populations and heights were

examined in detail in August by selecting 10 sub-plots at random within each treatment and averaging the measurements.

A summary of the observations is given in Appendices I, II and III.

6. OTHER OBSERVATIONS

ALBIN
- plot development was comparable to surrounding corn
- obvious contrast between rates and methods
- dry fertilizer treatments at both 150 and 50 lb./acre rates appeared to be more vigorous than the 28% treatments

PRONG
- in the fertilizer placement plot there was no visible evidence of fertilizer burn.

As in year 1 there were some skips in plant population for which an explanation is unclear. Since adjacent rows within the same planter pass did not show skips in the same areas, the problem cannot be attributed to inaccurate planting within the fertilized zone (ie. fertilizer burn if seed had been planted too close to fertilizer that was placed in a previous pass).

RESULTS - YEAR 2

1990 Studies

Fertilizer Zone-tiller vs. 28% Applicator - overview

Reliable results were obtained from the Albin plot (sandy loam) which showed a good response to nitrogen. Results showed that yields from the dry fertilizer treatments were 747 kg ha_{-1} and 1158 kg ha_{-1} higher than the 28% treatments, with and without coultering, respectively, (Table 6 - Avg. at 150 kg N ha_{-1}). Other crop growth parameters (full biomass, 6-leaf biomass, biomass N and Tissue N) also showed that the dry fertilizer system performed significantly (Prob $\leq$ .10) better than the 28% methods (Table 7 - 150 kg N ha_{-1}). With respect to time of application, there was no significant difference in yields. Thus Year 1 results (which indicated better response when nitrogen was applied at planting) are inconclusive.

The Prong - clay loam plot did not show a significant response to nitrogen (Table 9); this indicates that pre-plot soil reserves of nitrogen were higher than expected. Nevertheless, results indicated that the fertilizer zone-tiller performed at least as well as the 28% method.

There was a positive response to coultering at the Albin - sandy loam plot (Table 6) but a negative response on the Prong - clay loam plot (Table 9). Therefore we cannot draw any conclusions about the effects of coultering.

A summary of the various measurements taken at the Albin (28% N vs. Urea), Prong (28%N vs. Urea), and Prong (Urea placement) experiments, along with the analysis of variance are given in Appendices I, II and III respectively. The experiments will be discussed individually, then an overall summary given. A summary of the yield and analysis of variance data for Albin 1989 (28% N vs. Urea) is given in Appendix IV.

Albin (28% N vs. Urea applicator) - 1990

The average crop response to applied fertilizer N over all application methods and times of application is given in Table 5. The data indicate a statistically significant (Prob ≤ 0.05) effect of applied fertilizer N for most crop characteristics except plant population (as expected). Corn grain yield (15.5% wt.) and total crop biomass (dry wt.) increased by approximately 52.2 bu ac^{-1} and 10 kg ha^{-1} respectively with the addition of 150 kg N ha^{-1}. This compares with an increase of 31.1 bu ac^{-1} grain yield and 6000 kg ha^{-1} biomass for the addition of 156 kg N ha^{-1} in 1989. The strong response to fertilizer N in both years at this site make it a valid site to test N fertilizer application systems.

Table 5. Average crop measurements as a function of applied N fertilizer, Albin 1990

	Applied N fertilizer (kg N ha^{-1})		
Measurement	0	50	150
Yield (bu ac^{-1})	53.3[a]	71.6[b]	105.5[c]
6 leaf Biomass (kg ha^{-1})	138[a*]	164[ab*]	184[b*]
Full Biomass (tonnes ha^{-1})	13.1[a]	14.5[a]	23.9[b]
Biomass N (kg ha^{-1})	111[a]	106[a]	237[b]
Tissue N (%)	0.84[a]	0.73[a]	0.99[b]
12 leaf Plant # (pl m^{-1})	5.8[a]	5.7[a]	5.8[a]
# cobs (cobs m^{-1})	4.2[a]	4.6[a]	4.6[a]

Values in the same row with different letters are significantly different at Prob ≤ 0.05.
* significantly different at 0.10 level.

A summary of the analysis of variance for treatment effects on corn grain yield (Albin 1990) is given in Appendix I, Table I.8. As indicated there was a very significant (Prob ≤ 0.001) effect of fertilizer application system (FERT) and fertilizer amount (DOSE), on grain yield (Appendix I, Table I.8.). The time of fertilizer application (TIME) was not significant. The yields at both times of application were averaged for each application type and fertilizer amount, before testing for specific differences among mean values using the Duncan-Wallis multiple range test. The data are summarized in Table 6.

As indicated in Table 6, there was a significant increase in yield in the Urea - coultering system (U) over both the 28% N method (coultering LC, and without coultering L). The difference was significant for both N rates, but at a slightly reduced probability (Prob ≤ 0.07) at the 150 kg N ha^{-1} rate. The average yield gain in the U system was 18.5 bu ac^{-1} and 25.3 bu ac^{-1} over the LC and L systems respectively (significant at the 0.05 level). The extra coultering with the LC system had higher average yields than the L system at both N rates, but the difference was not enough for it to be significant at the 0.10 probability level.

The other measured plant parameters are summarized in Table 7. Biomass and total plant N uptake were affected by treatment in a manner similar to yield. The urea application system (U) seems to give better crop response than either the LC or L treatment. The LC treatment was higher than the L treatment in biomass and N uptake at the low rate of applied N, but the opposite was true at high N applied. This supports the yield data suggesting a small but statistically insignificant effect of LC over L treatments. A summary of the analysis of variance for the plant measurements is given in Appendix I. As in the 1989 data, the treatment effects are not related to emergence or plant survival. The treatments had no significant effects on the number of plants at the 12 leaf stage or the number of cobs harvested per unit row length (Table 7).

Table 6. Yield measurements at Albin site (1990)
(28%N vs Urea applicator)

Fertilizer Application	Corn Grain Yield (bu ac^{-1})					
	50 kg N ha^{-1} applied			150 kg N ha^{-1} applied		
Method	Planting[1]	6 leaf[1]	Avg	Planting[1]	6 leaf[1]	Avg
28% sidedress	65.5	51.6	58.5[a]	88.2	93.4	90.8[A]
28% sidedress + Coultering	71.0	60.2	65.6[a]	102.8	91.9	97.4[AB]
Urea sidedress + Coultering	78.3	102.8	90.6[b]	111.5	107.1	109.3[B]

[1] Time of application

Values in the same column with different small letters are significantly different at Prob ≤ 0.05.

Values in the same column with different capital letters are significantly at Prob ≤ 0.07.

Table 7. Measured crop growth parameters for Albin site (1990)

	Measured Plant Parameters					
	50 kg N ha^{-1} applied			150 kg N ha^{-1} applied		
	L	LC	U	L	LC	U
Full Biomass (tonne ha^{-1})	11.3[a]	16.2[a]	16.0[a]	21.1[b]	18.3[ab]	32.2[c]
Biomass 6L (kg ha^{-1})	158[ab]	181[ab]	210[b]	130[a]	140[ab]	208[ab]
Biomass N (kg N ha^{-1})	84[a]	114[ab]	121[ab]	200[b]	175[ab]	337[c]
Tissue N (%)	0.74[a]	0.70[a]	0.70[a]	0.95[a]	0.90[a]	1.05[b]
12 lf # plants (pl/m)	5.7[a]	5.7[a]	5.9[a]	5.6[a]	5.6[a]	6.2[a]
# cobs (cobs/m)	4.3[a]	4.7[a]	4.7[a]	4.6[a]	4.6[a]	4.7[a]

L = 28% N sidedress, LC = 28% N sidedress + coultered, U = Urea + coultered

Values in the same row with different letters are significantly different at the 0.10 probability level.

[a] Values are significantly different at the 0.05 probability level.

The 1989 data for the Albin site suggested that the urea zone-till system had a slight negative effect on corn yield response compared to the 28% N. However, the yield loss was slight and not significant. The addition of the starter fertilizer N with the urea zone-till system in 1990, and the increased placement distance appears to have eliminated any small negative effects the urea system had on grain yield, and in fact significantly increased the yield. While we suspect both were factors, further study would be necessary to reliably identify the reason(s) for the improvement. The coultering effect (zone-till) did not appear to increase the yield response using 28% N.

The 1989 data also showed a significant increase (Prob $\leq$ 0.11) in yield for the N applied at planting. The analysis of variance did not indicate time of application was significant in 1990 (Appendix I, Table I.8.). However, the 1990 data show a possible TIME interaction with dose and fertilizer application type (Prob $\leq$ 0.08). The data in Table 6 indicate that except for the urea 50 kg N ha^{-1} treatment, all treatments had higher yields for the planting application compared to the 6 leaf application. The high yield of the 6 leaf urea 50 kg N ha^{-1} treatment is possibly masking the time effect and creating a time interaction with Dose and Fertilizer application. However, the time effect is certainly not as strong as in the 1989 experiment.

Prong site (28% N vs. Urea applicator)

A summary of the effects of N fertilizer application rate on measured plant parameters is given in Table 8. The response to applied N at this site is smaller than the Albin site. There is a significant yield gain for both the 50 kg N ha^{-1} and the 150 kg N ha^{-1} treatments over the check (0 kg N ha^{-1}) treatment, but no significant difference between the 50 and 150 kg N ha^{-1} treatments. Similar trends were observed for the other measured plant parameters. The increase in yield for the 50 kg N ha^{-1} treatment (over the check) is an economic increase[3], but the yield gain from 50 to 150 kg N ha^{-1} is not. The yield response is similar to that observed in Albin 1989.

[3] An economic increase is defined as the situation where the marginal return is greater than the marginal cost assuming a price ratio equal to 5 (ie. the cost of a kg. of fertilizer is five times the value of a kg. of grain)

Table 8. Average crop measurements as a function of applied N fertilizer, Prong site (1990).

	Applied N fertilizer (kg N ha^{-1})		
Measurement	0	50	150
Yield (bu ac^{-1})	100.2[a]	113.0[b]	114.7[b]
6 leaf Biomass (kg ha^{-1})	73[a*]	89[b*]	91[b*]
Full Biomass (tonne ha^{-1})	38.8[a]	43.7[ab]	45.9[b]
Biomass N (kg N ha^{-1})	394[a]	337[a]	429[b]
Tissue N (%)	1.02[a]	0.77[a]	0.93[a]
12 leaf Plant # (pl m^{-1})	5.8[a]	5.8[a]	5.9[a]
# cobs (cobs m^{-1})	4.7[a]	5.1[b]	5.2[b]

Values in the same row with different letters are significantly different at the 0.05 probability level.
* significantly different at the 0.10 probability level.

Since check yield is being used as a covariate, the analysis of variance (Appendix II, Table II.10.) for yield against the treatments indicated only a 0.18 probability level for yield response to applied N rate. No other factor were significant in the overall analysis of variance. A summary of yield data collected is given in Table 9.

Table 9. Corn grain response to treatments at Prong site 1990. (28%N vs Urea applicator)

Fertilizer Application	Corn Grain Yield (bu ac^{-1})					
	50 kg N ha^{-1} applied			150 kg N ha^{-1} applied		
Method	Planting[1]	6 leaf[1]	Avg	Planting[1]	6 leaf[1]	Avg
28% sidedress	111.1	116.9	114.0	115.9	118.6	117.2
28% sidedress + Coultering	103.9	109.4	106.6	107.9	105.2	106.5
Urea sidedress + Coultering	130.1	106.9	117.0	121.1	119.5	120.3

[1] Time of application

A summary of the yield data averaged across N rates and application time is given in Table 10 and indicates the U and L treatments are significantly higher (prob ≤ 0.10) than the LC treatment. The 6 leaf biomass values indicated a similar effect with U and L significantly different than LC (Appendix II). None of the other plant measurements were significantly different. The effects were not picked up as significant in the overall analysis of variance. The lower yields in the LC treatment may be due to the very wet spring and poor conditions at the site during the coultering.

In summary, the data suggest that at the 0.10 probability level there was a slight advantage of the L and U treatments over the LC treatment, but there was no significant difference between the L and U treatment. The decrease in yield in the LC treatment is attributed to the coultering effect, which in this case decreased the yield. Since the coultering is also used in the Urea treatment, the decreased yield from the coultering may be offsetting the increased yield in the U over the L treatment which was measured in the Albin site. The negative effect of coultering on this site and the low N response make conclusions difficult. However, the new Urea zone-tilled applicator (U) was at least as good as the L method, and slightly better (0.10 probability level) than the LC method (Table 10).

Table 10. Average grain response to treatments at Prong 1990

Fertilizer Method	Corn Grain Yield (bu ac^{-1})		
	Planting	6 leaf	Avg
28% sidedress	113.5^{ab}	117.7^{a}	115.6^{b}
28% sidedress + Coultering	105.9^{a}	107.3^{a}	106.6^{a}
Urea sidedress + Coultering	125.6^{b}	113.2^{a}	119.4^{b}

Values in the same column with different small letters are significantly different at the 0.10 probability level.

Prong site Urea placement.

When the urea was applied at planting, there were no conclusive effects of varying widths and depths. However, yields were significantly lower when urea was placed 25 cm from the plant at the 6 leaf stage with treatments at the 15 cm depth yielding the least. This result could be explained either by toxicity or possibly by root damage that may have occurred while sidedressing. We assume the urea was available to the plant (6 leaf stage) at the 25 cm width, since the yields at planting indicate higher yields at the 25 cm width than at closer distances (Table 11).

A review of results (Table 11) suggests that volatilization was not a factor in the lower response to urea vs. 28% seen in Year 1.

A summary of the analysis of variance on yield response to the urea placement treatment is given in Appendix III, Table III.8.. As indicated there were significant effects for both width, depth, and time of placement. A summary of the yield data is given in Table 11. The most significant (prob $\leq$ 0.001) effect is the decrease in yield in the 6 leaf application treatment for both depths at the 25 cm width placement. This is a very significant effect which was also measured, but not picked up as significant in the previous Albin (1989) experiment. The increased replication of only Urea at different times and placement in this experiment allowed the difference to be measured as significant. An analysis of the Depth x Time (DxT) interaction (Appendix III) indicated that the 6 leaf - 15 cm depth treatment was also significantly lower (prob $\leq$ 0.05) than the 6 leaf - 5 cm treatment.

In order to analyze the effect of Depth and Width without the confounding effects of the 6 leaf time placement, a second analysis of variance was completed for only the treatments applied at time of planting. This is summarized in Appendix III, Table III.9., and indicates that once the effects of time of application are excluded, no other significant effects are measured. Analysis of variance was completed on all other plant parameters and the same effects were obtained.

Table 11. Grain yield response to placement of urea
Urea zone-till system, Prong 1990

Corn Grain Yield (bu ac^{-1})

	Width (cm)				
	Planting application				6 leaf appl.
Depth (cm)	10	15	25	Avg	25
5 cm	119.9	108.0	121.1	116.5	93.1[A]
15 cm	105.8	116.2	120.8	114.3[a]	69.3[A]
Average	112.9[a]	112.3[a]	121.0[a]	115.4	81.2

A Sites are significantly different than other measured yields at the 0.0001 probability level and significantly different from each other at the 0.05 probability level.

Values in the same row with different lower case letters are significantly different at the 0.05 probability level.

ECONOMIC IMPLICATIONS

Timing of Application

During this study, there were no yield advantages to the application of urea at the 6 leaf stage. Consequently, there would be an economic advantage to the fertilizer zone-tiller if this machine was pulled in tandem with the planter thus eliminating one field pass.

Fuel Consumption

There were no significant differences in fuel consumption or time required to apply fertilizer with the fertilizer zone-tiller vs. the 28% applicator.

Fertilizer Costs

With transportation costs, liquid 28% N is usually more expensive per kg. N applied than is urea.

While relative costs may vary from time to time, based on fertilizer prices obtained in the spring of 1991, the dry fertilizer combination (20% ammonium nitrate + 80% urea) was 6.6% cheaper (per kg. of N) than liquid 28% N.
Therefore, with dry fertilizer yields equal or better than 28% yields, there is an economic advantage to the dry fertilizer system described.

EQUIPMENT DEVELOPMENT AND MODIFICATIONS

1. OPERATIONAL PERFORMANCE - YEAR 1

In year 1, the four-row prototype was a pull-type machine. Two John Deere fertilizer boxes distributed the urea to 4 main hoses. A splitter device, designed by Till-Tech, directed the fertilizer to the two fertilizer attachments servicing each row.

Performance during plot use was generally good. The coulters (two per row) tilled a seed zone approximately 25 cm wide. Two types of fertilizer attachments were used. Three rows were equipped with disc openers and one outside row with back-swept knives (two attachments per row). No visual difference in the operational performance of these attachments was detectable. It should be noted that since test data were taken from sub-plots located in the middle two rows, the fertilizer attachment type is not a variable in the data.

In addition to plot use, the machine was field tested by Mr. Albin who used it to side-dress about 135 acres of corn. During this larger scale operation, some problems were encountered and these are described below.

2. PROBLEMS AND SOLUTIONS

During Planting

- visual inspection of fertilizer boxes during operation indicated that the fertilizer was flowing freely

- it was found that the fertilizer attachment adjusting mechanism for depth was not maintaining adequate depth control.

Solution: The adjusting mechanism was removed. Depth control now achieved by adjusting the coulter unit.

During Side-dressing

- it was necessary, due to a drier (harder) soil (vs. at planting), to add temporary weights in order to maintain an even coulter depth. This adjustment was made prior to entering the plot. The problem wasn't observed when the plot was planted.

Solution: Installation of weight brackets.

During Side-dressing (cont'd)

- it was observed that the machine tramped some corn when turning. This was due, in large part, to the fact that it was originally constructed as a pull-type machine rather than as a 3-point hitch with caster wheels. The machine was converted to a 3-point hitch draw method, with lift-assist wheels, prior to planting in 1990.

During Field-testing

During early July, 1989, Mr. Albin field tested the machine by using it to side-dress some 135 acres of corn. The larger scale use of the machine unveiled the following problems:

1) With greater vibration, the fertilizer tubes worked themselves loose at the point where they joined the fertilizer attachments.

Solution: A more secure attachment method.

2) Due to air humidity, the urea fertilizer was gumming in the splitting device (which directed the fertilizer to both sides of the row for a split application).

Solution: Modification to install an air delivery system.
Benefits:
- only one large fertilizer box would be required
- a more consistent fertilizer application rate

3. OPERATIONAL PERFORMANCE - YEAR 2

In the winter of 1990, the machine was converted to a three-point hitch type with lift-assist wheels. A Beline air delivery fertilizer box was mounted on the frame. The splitters were removed such that fertilizer was metered into 8 hoses (2 per row).

Calibration occurred at the Albin farm on May 7th. Plot work was delayed on May 8th since air humidity was causing the urea to stick and the fertilizer was not flowing properly. By mid afternoon however, the weather conditions had changed such that the dry fertilizer flowed smoothly. Similar problems were not experienced at the Prong - clay loam site.

4. EQUIPMENT DESIGN AND SPECIFICATIONS

The machine was designed and constructed by Till-Tech Systems Limited (Till-Tech). The following specifications describe the prototype machine as is and DO NOT necessarily describe fertilizer zone-tillers produced for sale after March 31, 1991.

. Hitch mounted	
. Working width	12 feet
. No. of toolbars	1
. Toolbar gage/dimensions	4" x 4" x .250"
. Spring-loaded, swivel coulters	2 per row
. Coulter type	2 inch wavy blades
. Method of depth control	Hydraulic
. Transport width	12 feet
. Transport length	10 feet
. No. of wheels	2
. No. of rows	4
. Hopper capacity	22 cu. ft.
. Hopper material	steel painted with epoxy paint
. Hopper equipped with agitator?	No
. Application rate - Min. (lbs./acre)	3
. Application rate - Max. (lbs./acre	180
. Distributor fan diameter - inches	13
. Distributor fan speed	3000 RPM
. Dist. fan - # of blades	44
. Fan driven by	Hydraulic motor
. Metering Drive System	Electronically driven; in-cab control regulates the speed of the metering system in conjunction with a ground speed compensation system

Front view
of coulter and disc opener
for left side of Row 1

Lateral view of
Fertilizer Zone-tiller
showing 3-bar construction

5. ENHANCEMENTS NEEDED FOR COMMERCIAL USE

1) Metering system. The roller-type metering device in the air delivery unit on the machine did not satisfactorily accommodate sticky product which resulted from humid conditions.

Solution: We feel a chain delivery system would ensure more accurate distribution of the product to all fertilizer attachments.
Secondly, an agitator in the fertilizer box would break up any product that was sticking prior to it reaching the chain metering device.

2) Marking system. A marking system was not required for the purposes of this study as "natural" markers were available (ie. previous crop rows) in both proposed plots. However, when corn is planted into the residue of soybeans or small grains, natural markers may not always be distinguishable. Since the normal, or recommended, practice in no-till situations is a crop rotation that includes only 1 year of corn, a marking system would be necessary to make this machine suitable for commercial use.
Funding for a marking system was approved for year 2 of this project however, the markers were back-ordered until after planting. Consequently, markers were neither installed nor charged as a project expense.

SUMMARY

Table 12 gives an overall summary of corn grain yield for the different site/treatment/years. For the 12 comparisons (rate/year/placement of 28% (L) versus dry form N, the dry fertilizer (U) treatment was only lower for 3 comparisons. In fact, the U treatment is almost statistically significantly higher than the L treatment, overall. This and the fact that the U treatment was statistically higher than the L treatment at the Albin farm (1990) indicates that the dry fertilizer system as tested is *at least* as good as the 28% liquid treatment[1].

The comparable performance of the Urea system is attributed to some combination of split placement (both sides of row), starter N in ammonium nitrate form (20% of total nitrogen)[2], and possibly the coultering system.

Table 12. Overall yield summary for different site/treatment/years

	Corn Grain Yield (bu ac^{-1})			
	Planting		6 leaf	
Site/Treatment	28% N	Urea	28% N	Urea
ALBIN 50 kg, 1989	93.1	94.2	86.4	80.8
ALBIN 150 kg, 1989	102.2	89.2	88.1	86.5
ALBIN 50 kg, 1990	65.5	78.3	51.6	102.8
ALBIN 150 kg, 1990	88.2	111.5	93.4	107.1
PRONG 50 kg, 1990	111.1	130.1	116.9	106.9
PRONG 150 kg, 1990	115.9	121.1	118.6	119.5
Average	96.0	104.1	92.5	100.6
UD1/1990	--	121.1	--	93.1
UD2/1990	--	120.8	--	69.3
Average		108.3		95.8

[1] The experiment cannot conclude that Urea fertilizer is better than 28% N fertilizer, since this was not tested.

[2] More work needs to be done on the specific effects of the starter N, and time of application.

The fertilizer zone-tiller/dry fertilizer system yields an **economic advantage** when the fertilizer costs are compared; urea is usually a cheaper source of nitrogen, since less product is transported when it is used (compared to liquid 28% N).

Other advantages of the fertilizer zone-tiller, as it facilitates dry fertilizer placement, are seen as follows:

Environmental risks are lower when using dry fertilizer vs. liquid 28% N since liquid more readily percolates through the soil if spilled.

It is a readily adaptable fertilizer system for the many farmers who are already equipped to handle dry fertilizer. In contrast, storage tanks and injection pumping equipment are required when liquid 28% is used. Furthermore, environmental legislation in Ontario requires that special containment facilities be constructed if liquid 28% is stored on farm.

Dry fertilizer is available to a wider cross-section of farmers (ie. in some parts of Ontario, liquid 28% is not an option due to availability/cost).

In conclusion, given the economic and environmental advantages of the dry fertilizer system tested, the fertilizer zone-tiller is clearly a viable, if not preferable, option for fertilizer placement in conservation-tillage programmes.

PROJECT PUBLICITY

* Innovative Farmers of Ontario - a group of 75-100 producers toured the plot on June 26th, 1990; they expressed interest in knowing the effects of varied fertilizer placement.

* Brant Cty. plot was included in a self-guided tour organized by the Grand River Conservation Authority. The plot is appropriately posted with signs.

* Information about the plot was available at the International Plowing Match, hosted by Brant Cty. in 1990.

* Plot sites posted with SWEEP - TED signs.

* Paris Star - project mentioned in an article featuring Mr. Albin. He was interviewed in connection with his receiving a Certificate of Appreciation from the Grand River Conservation Authority for his efforts in promoting soil conservation to county farmers.

* Country Guide - article entitled "Machinery made for residue" (December 1990) described the fertilizer zone-tiller ("urea placer") and its benefits.

* Brant Conservation Competition annual meeting - Feb. 1991 Dr. Kachanoski mentioned the project as part of his presentation. Considerable interest was shown by those in attendance.

* 1990, 1991 TED Conferences

APPENDIX I

ALBIN SITE - 1990

28% Liquid N vs Urea Applicator

Measurements and Statistical Analysis

TABLE I.1.
ALBIN 90 Biomass
6 Leaf Stage [kg/ha]

Treatm	Block I D_Chk	Block I Trmt	Block I D_Trmt	Block II D_Chk	Block II Trmt	Block II D_Trmt	Block III D_Chk	Block III Trmt	Block III D_Trmt
L__050_1	141	194	53	129	115	-14	151	105	-46
L__050_2	189	162	-27	144	215	71	NA	NA	NA
L__150_1	112	186	74	149	114	-34	NA	NA	NA
L__150_2	127	119	-8	NA	NA	NA	157	100	-57
LC_050_1	138	281	142	104	169	65	147	103	-44
LC_050_2	101	133	32	157	262	104	114	136	22
LC_150_1	NA	NA	NA	130	152	21	110	172	62
LC_150_2	161	158	-4	110	108	-2	156	111	-45
U__050_1	224	126	-98	116	211	103	145	265	120
U__050_2	116	149	33	128	231	103	112	280	168
U__150_1	110	148	37	153	184	31	169	103	-67
U__150_2	195	127	-68	103	178	76	116	307	190

Averages

Treatm	D_Chk	Trmt	D_Trmt
L__050_1	140	138	-2
L__050_2	166	188	22
L__150_1	130	150	20
L__150_2	142	110	-32
LC_050_1	130	184	54
LC_050_2	124	177	53
LC_150_1	120	162	42
LC_150_2	142	125	-17
U__050_1	162	201	39
U__050_2	119	220	102
U__150_1	144	145	0
U__150_2	138	204	66

TABLE I.2.

ALBIN 90

Plant Density
[pl/m^2]

Treatm	Block I A_Chk	Block I Trmt	Block I D_Trmt	Block II A_Chk	Block II Trmt	Block II D_Trmt	Block III A_Chk	Block III Trmt	Block III D_Trmt
L__050_1	6.25	6.52	0.27	6.52	5.43	-1.09	5.98	5.43	-0.54
L__050_2	7.07	6.52	-0.54	6.93	6.52	-0.41	5.71	6.25	0.54
L__150_1	6.11	5.98	-0.14	5.71	5.71	0.00	6.52	6.52	0.00
L__150_2	6.79	6.25	-0.54	7.07	6.79	-0.27	6.25	5.16	-1.09
LC_050_1	6.66	6.52	-0.14	6.11	6.25	0.14	7.07	6.25	-0.82
LC_050_2	6.52	4.35	-2.17	5.57	5.98	0.41	6.39	7.61	1.22
LC_150_1	6.25	6.52	0.27	5.03	6.25	1.22	6.25	6.52	0.27
LC_150_2	7.20	6.25	-0.95	5.43	4.62	-0.82	6.25	6.25	0.00
U__050_1	6.66	6.52	-0.14	6.79	6.52	-0.27	6.52	6.25	-0.27
U__050_2	5.43	5.71	0.27	5.57	6.25	0.68	5.43	7.34	1.90
U__150_1	6.66	5.98	-0.68	6.39	6.25	-0.14	6.11	6.79	0.68
U__150_2	6.52	6.25	-0.27	6.25	6.52	0.27	6.39	8.15	1.77

Average

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	6.25	5.80	-0.45
L__050_2	6.57	6.43	-0.14
L__150_1	6.11	6.07	-0.05
L__150_2	6.70	6.07	-0.63
LC_050_1	6.61	6.34	-0.27
LC_050_2	6.16	5.98	-0.18
LC_150_1	5.84	6.43	0.59
LC_150_2	6.30	5.71	-0.59
U__050_1	6.66	6.43	-0.23
U__050_2	5.48	6.43	0.95
U__150_1	6.39	6.34	-0.05
U__150_2	6.39	6.97	0.59

TABLE I.3.

ALBIN 90

Plant Count
[pl/12 m]

Treatm	Row Width [m]	Block I A_Chk	Block I Trmt	Block I D_Trmt	Block II A_Chk	Block II Trmt	Block II D_Trmt	Block III A_Chk	Block III Trmt	Block III D_Trmt
L__050_1	0.92	69.0	72.0	3.0	72.0	60.0	-12.0	66.0	60.0	-6.0
L__050_2	0.92	78.0	72.0	-6.0	76.5	72.0	-4.5	63.0	69.0	6.0
L__150_1	0.92	67.5	66.0	-1.5	63.0	63.0	0.0	72.0	72.0	0.0
L__150_2	0.92	75.0	69.0	-6.0	78.0	75.0	-3.0	69.0	57.0	-12.0
LC_050_1	0.92	73.5	72.0	-1.5	67.5	69.0	1.5	78.0	69.0	-9.0
LC_050_2	0.92	72.0	48.0	-24.0	61.5	66.0	4.5	70.5	84.0	13.5
LC_150_1	0.92	69.0	72.0	3.0	55.5	69.0	13.5	69.0	72.0	3.0
LC_150_2	0.92	79.5	69.0	-10.5	60.0	51.0	-9.0	69.0	69.0	0.0
U__050_1	0.92	73.5	72.0	-1.5	75.0	72.0	-3.0	72.0	69.0	-3.0
U__050_2	0.92	60.0	63.0	3.0	61.5	69.0	7.5	60.0	81.0	21.0
U__150_1	0.92	73.5	66.0	-7.5	70.5	69.0	-1.5	67.5	75.0	7.5
U__150_2	0.92	72.0	69.0	-3.0	69.0	72.0	3.0	70.5	90.0	19.5

Averages

Treatm	[m]	A_Chk	Trmt	D_Trmt
L__050_1	0.92	69.0	64.0	-5.0
L__050_2	0.92	72.5	71.0	-1.5
L__150_1	0.92	67.5	67.0	-0.5
L__150_2	0.92	74.0	67.0	-7.0
LC_050_1	0.92	73.0	70.0	-3.0
LC_050_2	0.92	68.0	66.0	-2.0
LC_150_1	0.92	64.5	71.0	6.5
LC_150_2	0.92	69.5	63.0	-6.5
U__050_1	0.92	73.5	71.0	-2.5
U__050_2	0.92	60.5	71.0	10.5
U__150_1	0.92	70.5	70.0	-0.5
U__150_2	0.92	70.5	77.0	6.5

TABLE I.4.

ALBIN 90
Full Plant

Biomass
[kg/ha]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
L__050_1	10322	12131	1809	21803	24809	3005	10902	9344	-1557
L__050_2	19087	7770	-11317	19201	6918	-12283	9871	6975	-2895
L__150_1	10755	17101	6346	7667	27770	20104	13246	16623	3377
L__150_2	9045	17973	8928	14847	15061	214	7962	32186	24224
LC_050_1	19291	35475	16184	14593	12443	-2150	14314	8609	-5705
LC_050_2	12973	21552	8579	8307	9046	740	10279	9792	-487
LC_150_1	11343	12164	821	10269	10281	12	10654	32459	21805
LC_150_2	27477	26393	-1083	11570	12820	1250	12809	15522	2713
U__050_1	16679	13148	-3531	15846	31869	16023	13969	11531	-2438
U__050_2	6796	12480	5683	11608	12938	1330	8132	13943	5811
U__150_1	10736	43760	33024	12602	19261	6659	13256	32175	18919
U__150_2	15477	39025	23548	13728	19049	5321	13471	39918	26447

Averages

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	14342	15428	1086
L__050_2	16053	7221	-8832
L__150_1	10556	20498	9942
L__150_2	10618	21740	11122
LC_050_1	16066	18842	2776
LC_050_2	10520	13464	2944
LC_150_1	10755	18301	7546
LC_150_2	17285	18245	960
U__050_1	15498	18849	3351
U__050_2	8845	13120	4275
U__150_1	12198	31732	19534
U__150_2	14225	32664	18439

TABLE I.5.

ALBIN 90
Full Plant

Total N
[kg/ha]

Treatm	Block I A_Chk	Block I Trmt	Block I D_Trmt	Block II A_Chk	Block II Trmt	Block II D_Trmt	Block III A_Chk	Block III Trmt	Block III D_Trmt
L__050_1	89	79	-10	179	176	-3	96	103	7
L__050_2	164	67	-97	157	33	-124	87	46	-41
L__150_1	92	132	39	63	264	201	117	165	48
L__150_2	78	149	71	122	148	26	70	341	271
LC_050_1	166	248	82	120	81	-39	126	57	-69
LC_050_2	112	166	54	68	65	-3	90	66	-25
LC_150_1	98	137	40	84	76	-8	94	303	210
LC_150_2	236	243	7	95	124	29	113	166	53
U__050_1	143	85	-58	130	223	93	123	86	-36
U__050_2	58	106	48	95	118	23	72	110	39
U__150_1	92	468	376	103	212	109	117	347	231
U__150_2	133	406	273	113	219	106	119	371	253

Averages

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	121	119	-2
L__050_2	136	49	-87
L__150_1	91	187	96
L__150_2	90	213	123
LC_050_1	137	129	-9
LC_050_2	90	99	9
LC_150_1	92	172	81
LC_150_2	148	178	30
U__050_1	132	132	-0
U__050_2	75	111	36
U__150_1	104	343	238
U__150_2	121	332	211

TABLE I.6.

ALBIN 90
Full Plant

Total P
[kg/ha]

Treatm	Block I A_Chk	Block I Trmt	Block I D_Trmt	Block II A_Chk	Block II Trmt	Block II D_Trmt	Block III A_Chk	Block III Trmt	Block III D_Trmt
L__050_1	25	25	0	46	52	6	26	29	3
L__050_2	47	19	-27	40	13	-27	24	16	-7
L__150_1	26	17	-9	16	67	51	32	29	-3
L__150_2	22	225	202	31	33	2	19	66	47
LC_050_1	47	60	13	31	19	-11	34	21	-13
LC_050_2	32	41	9	17	19	2	25	23	-2
LC_150_1	28	43	15	22	12	-10	26	75	50
LC_150_2	67	49	-18	24	22	-2	31	40	9
U__050_1	41	22	-19	33	65	31	34	28	-6
U__050_2	17	11	-5	24	28	4	20	30	10
U__150_1	26	109	83	26	37	10	32	50	18
U__150_2	38	75	37	29	35	6	32	80	48

Averages

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	32	36	3
L__050_2	37	16	-20
L__150_1	25	38	13
L__150_2	24	108	84
LC_050_1	37	34	-4
LC_050_2	25	28	3
LC_150_1	25	43	18
LC_150_2	41	37	-4
U__050_1	36	38	2
U__050_2	20	23	3
U__150_1	28	65	37
U__150_2	33	63	30

TABLE I.6.

ALBIN 90

YIELD
Kg/ha
15.5 %

	Block I			Block II			Block III		
Trtm	A_Check	Trtm	D_Yield	A_Check	Trtm	D_Yield	A_Check	Trtm	D_Yield
L__050_1	3303	4028	725	2985	4240	1255	3802	4057	255
L__050_2	3412	3571	160	3365	3000	-365	3179	3137	-43
L__150_1	3516	6332	2816	3386	3184	-202	2940	7079	4139
L__150_2	3330	6853	3522	3339	6285	2946	3251	4448	1197
LC_050_1	3756	5101	1346	3382	4088	706	2906	4179	1274
LC_050_2	2980	4643	1664	3330	3906	576	2754	2784	30
LC_150_1	2969	7024	4056	4056	5724	1668	3083	6596	3513
LC_150_2	3690	7004	3315	4236	4414	178	2977	5887	2910
U__050_1	3325	5178	1853	3374	5094	1720	2781	4466	1686
U__050_2	3856	6225	2368	3503	6038	2534	3526	7095	3569
U__150_1	3229	7063	3834	3503	7951	4449	3797	5977	2181
U__150_2	3408	7085	3676	3360	5893	2533	2906	7179	4273

Averages

Trtm	A_Check	Trtm	D_Yield
L__050_1	3363	4108	745
L__050_2	3319	3236	-83
L__150_1	3280	5532	2251
L__150_2	3307	5862	2555
LC_050_1	3348	4456	1108
LC_050_2	3021	3778	757
LC_150_1	3369	6448	3079
LC_150_2	3634	5768	2134
U__050_1	3160	4913	1753
U__050_2	3629	6452	2824
U__150_1	3509	6997	3488
U__150_2	3225	6719	3494

TABLE I.6.

ALBIN 90 [Number of Cobs]

	Block I			Block II			Block III		
Treatm	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt
L__050_1	52.0	54.0	2.0	51.5	51.0	-0.5	47.5	53.0	5.5
L__050_2	56.0	54.0	-2.0	59.0	51.0	-8.0	50.0	49.0	-1.0
L__150_1	48.5	56.0	7.5	52.5	44.0	-8.5	55.0	58.0	3.0
L__150_2	50.5	66.0	15.5	52.0	60.0	8.0	49.0	47.0	-2.0
LC_050_1	54.0	59.0	5.0	53.0	52.0	-1.0	51.0	53.0	2.0
LC_050_2	51.0	49.0	-2.0	51.0	61.0	10.0	43.5	59.0	15.5
LC_150_1	49.0	59.0	10.0	45.0	57.0	12.0	47.0	58.0	11.0
LC_150_2	57.5	60.0	2.5	46.0	40.0	-6.0	51.5	54.0	2.5
U__050_1	51.0	53.0	2.0	60.0	63.0	3.0	52.0	55.0	3.0
U__050_2	45.0	53.0	8.0	48.0	56.0	8.0	49.0	62.0	13.0
U__150_1	51.5	57.0	5.5	50.0	60.0	10.0	44.0	54.0	10.0
U__150_2	52.5	54.0	1.5	50.5	49.0	-1.5	47.5	63.0	15.5

Averages

Treatm	D_Chk	Trmt	D_Trmt
L__050_1	50.3	52.7	2.3
L__050_2	55.0	51.3	-3.7
L__150_1	52.0	52.7	0.7
L__150_2	50.5	57.7	7.2
LC_050_1	52.7	54.7	2.0
LC_050_2	48.5	56.3	7.8
LC_150_1	47.0	58.0	11.0
LC_150_2	51.7	51.3	-0.3
U__050_1	54.3	57.0	2.7
U__050_2	47.3	57.0	9.7
U__150_1	48.5	57.0	8.5
U__150_2	50.2	55.3	5.2

TABLE I.7. Soil Analysis

ALBIN 90 Soil P and K contents
[mg/Kg]

Sample B	#	0-15 cm P	0-15 cm K	15-60 cm P	15-60 cm K
1	1	13	221		
1	2	26	134	21	50
1	3	25	169	19	114
1	4	29	252	27	95
2	1	16	273	18	128
2	2	24	207	12	98
2	3	36	288	22	81
2	4	36	180	15	101
3	1	23	225	22	51
3	2	30	216	22	65
3	3	27	212	38	100
3	4	23	279	14	106
Avg		26	221	21	90
Std		7	45	7	24
CV		26	20	32	27

Fertilizer req., [kg/ha]
20 0

Soil N Content
[mg N/Kg]

Sample B	#	0-15 cm NH4	0-15 cm NO3	15-60 cm NH4	15-60 cm NO3
1	1	1.82	0.94	3.90	1.40
1	2	1.17	1.03	0.00	2.51
1	3	2.28	2.12	0.00	0.00
1	4	1.74	2.83	2.13	0.50
2	1	9.57	3.41	13.40	2.92
2	2	1.67	1.97	0.09	0.00
2	3	2.76	2.89	0.00	0.00
2	4	2.69	1.23	0.00	0.00
3	1	2.33	3.48	9.49	2.51
3	2	3.81	10.12	5.32	1.25
3	3	16.96	3.76	7.39	1.52
3	4	1.75	1.42	5.79	0.03
Avg		4.05	2.93	3.96	1.05
Kg N/ha		8.19	17.82	8.02	6.40
Total		40.43			

x

TABLE I.8. Analysis of variance for corn grain yield for Albin - 1990

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	56681778.33	4048698.45	5.11	0.0004
Error	21	16639181.89	792341.99		
Corrected Total	35	73320960.22			

R-Square	C.V.	Root MSE	TRTM Mean
0.773064	16.62011	890.1359	5355.77778

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	4651731.06	2325865.53	2.94	0.0751
CHECK	1	849400.25	849400.25	1.07	0.3123
FERT	2	15660594.18	7830297.09	9.88	0.0009
DOSE	1	26599806.38	26599806.38	33.57	0.0001
FERT*DOSE	2	1429422.34	714711.17	0.90	0.4209
TIME	1	97947.81	97947.81	0.12	0.7286
FERT*TIME	2	2777779.49	1388889.74	1.75	0.1977
DOSE*TIME	1	100729.76	100729.76	0.13	0.7250
FERT*DOSE*TIME	2	4514367.06	2257183.53	2.85	0.0804

TABLE I.8. Analysis of variance for corn grain yield for Albin - 1990 (cont'd)

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	4841673.53	2420836.77	3.06	0.0684
CHECK	1	1175675.05	1175675.05	1.48	0.2367
FERT	2	16092706.33	8046353.17	10.16	0.0008
DOSE	1	26772033.65	26772033.65	33.79	0.0001
FERT*DOSE	2	1473283.96	736641.98	0.93	0.4103
TIME	1	97947.81	97947.81	0.12	0.7286
FERT*TIME	2	2780132.12	1390066.06	1.75	0.1974
DOSE*TIME	1	100729.76	100729.76	0.13	0.7250
FERT*DOSE*TIME	2	4514367.06	2257183.53	2.85	0.0804

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	56681778.33	4048698.45	5.11	0.0004
Error	21	16639181.89	792341.99		
Corrected Total	35	73320960.22			

R-Square	C.V.	Root MSE	TRTM Mean
0.773064	16.62011	890.1359	5355.77778

Nitrogen Type Experiment - ALBIN SITE - YIELD (cont'd)

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	4651731.06	2325865.53	2.94	0.0751
CHECK	1	849400.25	849400.25	1.07	0.3123
FERT	2	15660594.18	7830297.09	9.88	0.0009
DOSE	1	26599806.38	26599806.38	33.57	0.0001
FERT*DOSE	2	1429422.34	714711.17	0.90	0.4209
TIME	1	97947.81	97947.81	0.12	0.7286
FERT*TIME	2	2777779.49	1388889.74	1.75	0.1977
DOSE*TIME	1	100729.76	100729.76	0.13	0.7250
FERT*DOSE*TIME	2	4514367.06	2257183.53	2.85	0.0804

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	4841673.53	2420836.77	3.06	0.0684
CHECK	1	1175675.05	1175675.05	1.48	0.2367
FERT	2	16092706.33	8046353.17	10.16	0.0008
DOSE	1	26772033.65	26772033.65	33.79	0.0001
FERT*DOSE	2	1473283.96	736641.98	0.93	0.4103
TIME	1	97947.81	97947.81	0.12	0.7286
FERT*TIME	2	2780132.12	1390066.06	1.75	0.1974
DOSE*TIME	1	100729.76	100729.76	0.13	0.7250
FERT*DOSE*TIME	2	4514367.06	2257183.53	2.85	0.0804

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 792342

Number of Means	2	3
Critical Range	754.8	792.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	5842.3	12	1
A B A	5240.3	12	3
B B	4984.8	12	2

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 792342

Number of Means	2	3
Critical Range	754.8	792.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	6270.3	12	3
B	5112.5	12	2
B B	4684.5	12	1

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 792342

Number of Means 2
Critical Range 616.3

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	6221.0	18	2
B	4490.6	18	1

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 792342

Number of Means 2
Critical Range 616.3

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	5408.9	18	1
A			
A	5302.6	18	2

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6
FXT	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	52066681.51	4733334.68	5.34	0.0003
Error	24	21254278.71	885594.95		
Corrected Total	35	73320960.22			

R-Square	C.V.	Root MSE	TRTM Mean
0.710120	17.57094	941.0605	5355.77778

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	4651731.06	2325865.53	2.63	0.0930
CHECK	1	849400.25	849400.25	0.96	0.3372
FXD	5	43689822.90	8737964.58	9.87	0.0001
FXT	3	2875727.30	958575.77	1.08	0.3754

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	4654558.49	2327279.25	2.63	0.0929
CHECK	1	124227.90	124227.90	0.14	0.7113
FXD	3	28242820.97	9414273.66	10.63	0.0001
FXT	3	2875727.30	958575.77	1.08	0.3754

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 792342

Number of Means	2	3
Critical Range	754.8	792.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	5842.3	12	1
A			
B A	5240.3	12	3
B			
B	4984.8	12	2

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 24 MSE= 885594.9

Number of Means	2	3	4	5	6
Critical Range	1120	1177	1216	1240	1259

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	6858.0	6	6
A			
A	6108.2	6	4
A			
A	5696.8	6	2
A			
A	5682.7	6	5
B	4116.8	6	3
B			
B	3672.2	6	1

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 24 MSE= 885594.9

Number of Means	2	3	4	5	6
Critical Range	929	979	1012	1031	1047

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXD
	A	6858.0	6	6
	A			
B	A	6108.2	6	4
B				
B		5696.8	6	2
B				
B		5682.7	6	5
	C	4116.8	6	3
	C			
	C	3672.2	6	1

Nitrogen Type Experiment - ALBIN SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 24 MSE= 885594.9

Number of Means	2	3	4	5	6
Critical Range	929	979	1012	1031	1047

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXT
	A	6585.8	6	6
	A			
B	A	5954.8	6	5
B				
B	C	5452.0	6	3
	C			
	C	4820.0	6	1
	C			
	C	4773.0	6	4
	C			
	C	4549.0	6	2

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

NOTE: Due to missing values, only 32 observations can be used in this analysis.

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm
General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	42267.28772	3019.09198	0.64	0.8015
Error	17	80744.58728	4749.68160		
Corrected Total	31	123011.87500			

R-Square	C.V.	Root MSE	TRTM Mean
0.343603	39.36762	68.91793	175.062500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	3540.78409	1770.39205	0.37	0.6943
CHECK	1	951.80356	951.80356	0.20	0.6601
FERT	2	22797.03527	11398.51764	2.40	0.1208
DOSE	1	4529.21637	4529.21637	0.95	0.3425
FERT*DOSE	2	2282.34990	1141.17495	0.24	0.7890
TIME	1	19.12181	19.12181	0.00	0.9501
FERT*TIME	2	1149.33942	574.66971	0.12	0.8868
DOSE*TIME	1	3539.90416	3539.90416	0.75	0.4000
FERT*DOSE*TIME	2	3457.73314	1728.86657	0.36	0.7002

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3816.31088	1908.15544	0.40	0.6753
CHECK	1	1629.56435	1629.56435	0.34	0.5657
FERT	2	22560.84873	11280.42437	2.37	0.1231
DOSE	1	4403.22860	4403.22860	0.93	0.3491
FERT*DOSE	2	2066.17859	1033.08930	0.22	0.8067
TIME	1	19.12181	19.12181	0.00	0.9501
FERT*TIME	2	1181.35966	590.67983	0.12	0.8839
DOSE*TIME	1	3539.90416	3539.90416	0.75	0.4000
FERT*DOSE*TIME	2	3457.73314	1728.86657	0.36	0.7002

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 17 MSE= 4749.682
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 10.64516

Number of Means 2 3
Critical Range 51.93 54.64

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	188.00	10	3
A			
A	176.27	11	2
A			
A	162.09	11	1

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 17 MSE= 4749.682
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 10.51327

Number of Means 2 3
Critical Range 52.26 54.98

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	208.92	12	3
A			
B A	162.27	11	2
B			
B	145.56	9	1

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 17 MSE= 4749.682
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 15.9375

Number of Means 2
Critical Range 42.44

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	184.53	17	1
A			
A	164.33	15	2

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 17 MSE= 4749.682

Number of Means 2
Critical Range 42.36

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	176.62	16	1
A			
A	173.50	16	2

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

NOTE: Due to missing values, only 32 observations can be used in this analysis.

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	34101.18919	4262.64865	1.10	0.3970
Error	23	88910.68581	3865.68199		
Corrected Total	31	123011.87500			

R-Square	C.V.	Root MSE	TRTM Mean
0.277219	35.51566	62.17461	175.062500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	3540.78409	1770.39205	0.46	0.6382
CHECK	1	951.80356	951.80356	0.25	0.6245
FXD	5	29608.60154	5921.72031	1.53	0.2190

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	2456.16011	1228.08005	0.32	0.7310
CHECK	1	1458.55154	1458.55154	0.38	0.5451
FXD	5	29608.60154	5921.72031	1.53	0.2190

Nitrogen Type Experiment - ALBIN SITE - 6LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 23 MSE= 3865.682
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.217391

Number of Means	2	3	4	5	6
Critical Range	65.95	69.50	71.82	73.12	74.23

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXD
	A	210.33	6	5
	A			
	A	207.50	6	6
	A			
B	A	180.67	6	3
B	A			
B	A	158.20	5	1
B	A			
B	A	140.20	5	4
B				
B		129.75	4	2

xxx

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	2023135974	144509712	1.64	0.1484
Error	21	1850584448	88123069		
Corrected Total	35	3873720423			

R-Square	C.V.	Root MSE	TRTM Mean
0.522272	48.95540	9387.389	19175.3889

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	134118839.4	67059419.7	0.76	0.4797
CHECK	1	71978781.7	71978781.7	0.82	0.3764
FERT	2	463871224.4	231935612.2	2.63	0.0955
DOSE	1	867636531.6	867636531.6	9.85	0.0050
FERT*DOSE	2	318501712.5	159250856.3	1.81	0.1887
TIME	1	64733417.3	64733417.3	0.73	0.4011
FERT*TIME	2	14013548.7	7006774.3	0.08	0.9238
DOSE*TIME	1	28548002.5	28548002.5	0.32	0.5753
FERT*DOSE*TIME	2	59733916.0	29866958.0	0.34	0.7164

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	125427759.9	62713880.0	0.71	0.5023
CHECK	1	160938861.5	160938861.5	1.83	0.1909
FERT	2	464725909.6	232362954.8	2.64	0.0951
DOSE	1	869248180.3	869248180.3	9.86	0.0049
FERT*DOSE	2	312461454.3	156230727.1	1.77	0.1943
TIME	1	64733417.3	64733417.3	0.73	0.4011
FERT*TIME	2	10791913.8	5395956.9	0.06	0.9408
DOSE*TIME	1	28548002.5	28548002.5	0.32	0.5753
FERT*DOSE*TIME	2	59733916.0	29866958.0	0.34	0.7164

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 88123069

Number of Means	2	3
Critical Range	7960	8360

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	21581	12	1
A			
A	19090	12	3
A			
A	16855	12	2

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 88123069

Number of Means	2	3
Critical Range	7960	8360

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	24091	12	3
A			
A	17213	12	2
A			
A	16222	12	1

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 21 MSE= 88123069

Number of Means	2	3
Critical Range	6591	6944

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	21581	12	1
A			
A	19090	12	3
A			
A	16855	12	2

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 21 MSE= 88123069

Number of Means	2	3
Critical Range	6591	6944

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	24091	12	3
B	17213	12	2
B			
B	16222	12	1

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 88123069

Number of Means 2
Critical Range 6499

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	23863	18	2
B	14487	18	1

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 88123069

Number of Means 2
Critical Range 6499

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	20609	18	1
A			
A	17742	18	2

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6
FXT	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	1934854056	175895823	2.18	0.0538
Error	24	1938866367	80786099		
Corrected Total	35	3873720423			

R-Square	C.V.	Root MSE	TRTM Mean
0.499482	46.87315	8988.109	19175.3889

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	134118839	67059420	0.83	0.4481
CHECK	1	71978782	71978782	0.89	0.3546
FXD	5	1650009469	330001894	4.08	0.0080
FXT	3	78746966	26248989	0.32	0.8073

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	124597851	62298926	0.77	0.4736
CHECK	1	194144420	194144420	2.40	0.1342
FXD	3	1188716014	396238671	4.90	0.0085
FXT	3	78746966	26248989	0.32	0.8073

inter fxd .05

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 25 MSE= 76844411

Number of Means	2	3	4	5	6
Critical Range	10414	10942	11306	11529	11709

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	32198	6	6
B	21119	6	2
B			
B	18273	6	4
B			
B	16153	6	3
B			
B	15985	6	5
B			
B	11325	6	1

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 24 MSE= 80786099

Number of Means	2	3	4	5	6
Critical Range	8875	9355	9670	9845	9997

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	32198	6	6
B	21119	6	2
B	18273	6	4
B	16153	6	3
B	15985	6	5
B	11325	6	1

Nitrogen Type Experiment - ALBIN SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 24 MSE= 80786099

Number of Means	2	3	4	5	6
Critical Range	8875	9355	9670	9845	9997

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXT
	A	25291	6	5
	A			
B	A	22892	6	6
B	A			
B	A	18572	6	3
B	A			
B	A	17963	6	1
B	A			
B	A	15854	6	4
B				
B		14481	6	2

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	283293.6935	20235.2638	2.91	0.0134
Error	21	146207.3065	6962.2527		
Corrected Total	35	429501.0000			

R-Square	C.V.	Root MSE	TRTM Mean
0.659588	48.55875	83.44011	171.833333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	13692.1667	6846.0833	0.98	0.3906
CHECK	1	1272.1902	1272.1902	0.18	0.6734
FERT	2	60798.0917	30399.0459	4.37	0.0260
DOSE	1	160558.9531	160558.9531	23.06	0.0001
FERT*DOSE	2	35342.7537	17671.3768	2.54	0.1030
TIME	1	2120.6912	2120.6912	0.30	0.5868
FERT*TIME	2	551.9804	275.9902	0.04	0.9612
DOSE*TIME	1	1426.4087	1426.4087	0.20	0.6555
FERT*DOSE*TIME	2	7530.4578	3765.2289	0.54	0.5902

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	12626.0986	6313.0493	0.91	0.4191
CHECK	1	8451.8602	8451.8602	1.21	0.2830
FERT	2	61609.6584	30804.8292	4.42	0.0249
DOSE	1	160653.5213	160653.5213	23.07	0.0001
FERT*DOSE	2	35494.1082	17747.0541	2.55	0.1021
TIME	1	2120.6912	2120.6912	0.30	0.5868
FERT*TIME	2	432.4141	216.2070	0.03	0.9695
DOSE*TIME	1	1426.4087	1426.4087	0.20	0.6555
FERT*DOSE*TIME	2	7530.4578	3765.2289	0.54	0.5902

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 6962.253

Number of Means	2	3
Critical Range	70.75	74.31

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	190.50	12	1
A			
A	180.08	12	3
A			
A	144.92	12	2

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 6962.253

Number of Means	2	3
Critical Range	70.75	74.31

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	229.25	12	3
B	144.33	12	2
B			
B	141.92	12	1

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 6962.253

Number of Means 2
Critical Range 57.77

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	237.28	18	2
B	106.39	18	1

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 6962.253

Number of Means 2
Critical Range 57.77

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	180.11	18	1
A			
A	163.56	18	2

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm Interactions

General Linear Models Procedure
Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	264234.5000	37747.7857	6.40	0.0002
Error	28	165266.5000	5902.3750		
Corrected Total	35	429501.0000			

R-Square	C.V.	Root MSE	TRTM Mean
0.615213	44.71014	76.82692	171.833333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	13692.1667	6846.0833	1.16	0.3281
FXD	5	250542.3333	50108.4667	8.49	0.0001

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	13692.1667	6846.0833	1.16	0.3281
FXD	5	250542.3333	50108.4667	8.49	0.0001

Nitrogen Type Experiment - ALBIN SITE - TOTAL N
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 28 MSE= 5902.375

Number of Means	2	3	4	5	6
Critical Range	90.8	95.4	98.6	100.6	102.2

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	337.17	6	6
B	199.83	6	2
B C B	174.83	6	4
C B	121.33	6	5
C B C B	113.83	6	3
C C	84.00	6	1

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	423.9155801	30.2796843	0.99	0.4932
Error	21	640.8344199	30.5159248		
Corrected Total	35	1064.7500000			

R-Square	C.V.	Root MSE	TRTM Mean
0.398136	10.02866	5.524122	55.0833333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	39.5000000	19.7500000	0.65	0.5336
CHECK	1	16.5406427	16.5406427	0.54	0.4697
FERT	2	71.4317721	35.7158860	1.17	0.3297
DOSE	1	7.4125993	7.4125993	0.24	0.6272
FERT*DOSE	2	32.2141047	16.1070524	0.53	0.5975
TIME	1	1.5488495	1.5488495	0.05	0.8239
FERT*TIME	2	23.8623518	11.9311759	0.39	0.6812
DOSE*TIME	1	13.4426894	13.4426894	0.44	0.5141
FERT*DOSE*TIME	2	217.9625708	108.9812854	3.57	0.0462

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	87.3869634	43.6934817	1.43	0.2613
CHECK	1	180.9989135	180.9989135	5.93	0.0239
FERT	2	77.1499369	38.5749685	1.26	0.3031
DOSE	1	7.1295943	7.1295943	0.23	0.6338
FERT*DOSE	2	32.2464671	16.1232335	0.53	0.5972
TIME	1	1.5488495	1.5488495	0.05	0.8239
FERT*TIME	2	23.5407325	11.7703662	0.39	0.6847
DOSE*TIME	1	13.4426894	13.4426894	0.44	0.5141
FERT*DOSE*TIME	2	217.9625708	108.9812854	3.57	0.0462

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 30.51592

Number of Means	2	3
Critical Range	4.684	4.920

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	56.167	12	1
A			
A	55.417	12	3
A			
A	53.667	12	2

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 30.51592

Number of Means	2	3
Critical Range	4.684	4.920

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	56.583	12	3
A			
A	55.083	12	2
A			
A	53.583	12	1

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 30.51592

Number of Means 2
Critical Range 3.825

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	55.333	18	2
A			
A	54.833	18	1

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 30.51592

Number of Means 2
Critical Range 3.825

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	55.333	18	1
A			
A	54.833	18	2

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	127.7500000	18.2500000	0.55	0.7927
Error	28	937.0000000	33.4642857		
Corrected Total	35	1064.7500000			

R-Square	C.V.	Root MSE	TRTM Mean
0.119981	10.50196	5.784832	55.0833333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	39.50000000	19.75000000	0.59	0.5610
FXD	5	88.25000000	17.65000000	0.53	0.7535

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	39.50000000	19.75000000	0.59	0.5610
FXD	5	88.25000000	17.65000000	0.53	0.7535

Nitrogen Type Experiment - ALBIN SITE - COB NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 28 MSE= 33.46429

Number of Means	2	3	4	5	6
Critical Range	6.837	7.185	7.423	7.573	7.695

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	57.000	6	5
A			
A	56.167	6	6
A			
A	55.500	6	3
A			
A	55.167	6	2
A			
A	54.667	6	4
A			
A	52.000	6	1

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	848.5478729	60.6105624	0.98	0.4999
Error	21	1293.4521271	61.5929584		
Corrected Total	35	2142.0000000			

R-Square	C.V.	Root MSE	TRTM Mean
0.396147	11.37408	7.848118	69.0000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	190.5000000	95.2500000	1.55	0.2363
CHECK	1	94.9246569	94.9246569	1.54	0.2281
FERT	2	220.5248218	110.2624109	1.79	0.1915
DOSE	1	1.0000000	1.0000000	0.02	0.8998
FERT*DOSE	2	5.0678134	2.5339067	0.04	0.9598
TIME	1	2.2467730	2.2467730	0.04	0.8504
FERT*TIME	2	220.5495384	110.2747692	1.79	0.1914
DOSE*TIME	1	75.0630176	75.0630176	1.22	0.2821
FERT*DOSE*TIME	2	38.6712518	19.3356259	0.31	0.7339

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	243.3575503	121.6787752	1.98	0.1636
CHECK	1	178.0478729	178.0478729	2.89	0.1039
FERT	2	230.2534445	115.1267222	1.87	0.1790
DOSE	1	1.0000000	1.0000000	0.02	0.8998
FERT*DOSE	2	3.7606289	1.8803144	0.03	0.9700
TIME	1	2.2467730	2.2467730	0.04	0.8504
FERT*TIME	2	247.1138550	123.5569275	2.01	0.1595
DOSE*TIME	1	75.0630176	75.0630176	1.22	0.2821
FERT*DOSE*TIME	2	38.6712518	19.3356259	0.31	0.7339

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61.59296

Number of Means	2	3
Critical Range	6.655	6.989

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	72.250	12	3
A			
A	67.500	12	1
A			
A	67.250	12	2

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61.59296

Number of Means	2	3
Critical Range	6.655	6.989

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	72.250	12	3
A			
A	67.500	12	2
A			
A	67.250	12	1

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61.59296

Number of Means 2
Critical Range 5.434

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	69.167	18	2
A			
A	68.833	18	1

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61.59296

Number of Means 2
Critical Range 5.434

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	69.167	18	2
A			
A	68.833	18	1

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure
Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	403.5000000	57.6428571	0.93	0.5002
Error	28	1738.5000000	62.0892857		
Corrected Total	35	2142.0000000			

R-Square	C.V.	Root MSE	TRTM Mean
0.188375	11.41982	7.879675	69.0000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	190.5000000	95.2500000	1.53	0.2332
FXD	5	213.0000000	42.6000000	0.69	0.6379

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	190.5000000	95.2500000	1.53	0.2332
FXD	5	213.0000000	42.6000000	0.69	0.6379

Nitrogen Type Experiment - ALBIN SITE - PLANT NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 28 MSE= 62.08929

Number of Means	2	3	4	5	6
Critical Range	9.31	9.79	10.11	10.32	10.48

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	73.500	6	6
A			
A	71.000	6	5
A			
A	68.000	6	3
A			
A	67.500	6	1
A			
A	67.000	6	4
A			
A	67.000	6	2

APPENDIX II

PRONG SITE 1990

28% Liquid N vs Urea Applicator

Measurements and Statistical Analysis

TABLE II.1.

PRONG 1990
6 Leaf Stage

Biomass
[kg/ha]

	Block I			Block II			Block III		
Treatm	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt
L__050_1	50	34	-16	52	76	25	161	200	39
L__050_2	42	58	16	60	36	-24	72	136	64
L__150_1	38	40	2	47	56	8	0	86	86
L__150_2	20	37	16	58	60	1	160	171	11
LC_050_1	31	41	11	45	47	2	178	176	-2
LC_050_2	31	38	7	52	68	16	139	160	21
LC_150_1	61	56	-5	50	82	32	143	146	3
LC_150_2	38	47	9	48	62	14	133	145	12
U__050_1	46	83	38	56	71	14	143	186	43
U__050_2	33	27	-6	45	67	22	142	130	-13
U__150_1	24	48	24	55	82	27	113	154	41
U__150_2	41	59	18	45	51	5	158	220	62

TABLE II.1. (cont'd)

Averages

Treatm	D_Chk	Trmt	D_Trmt
L__050_1	87	103	16
L__050_2	58	77	19
L__150_1	28	61	32
L__150_2	80	89	9
LC_050_1	85	88	4
LC_050_2	74	89	15
LC_150_1	85	95	10
LC_150_2	73	85	12
U__050_1	82	113	32
U__050_2	74	75	1
U__150_1	64	95	31
U__150_2	82	110	28

TABLE II.2

PRONG 1990

Plant Density
[pl/m^2]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
L__050_1	6.56	5.46	-1.09	6.28	7.10	0.82	6.26	4.92	-1.34
L__050_2	5.19	6.01	0.82	7.10	7.65	0.55	7.79	6.39	-1.40
L__150_1	5.60	5.46	-0.14	6.69	5.46	-1.23	8.24	7.26	-0.99
L__150_2	5.87	6.83	0.96	5.46	6.01	0.55	7.57	6.56	-1.01
LC_050_1	6.28	6.28	-0.00	5.74	6.01	0.27	6.95	7.07	0.11
LC_050_2	5.60	6.83	1.23	6.69	4.92	-1.78	5.98	6.18	0.20
LC_150_1	6.83	6.83	0.00	6.69	6.56	-0.14	5.96	7.53	1.57
LC_150_2	5.74	6.01	0.27	6.28	6.28	-0.00	6.52	7.80	1.28
U__050_1	6.15	6.01	-0.14	6.15	5.74	-0.41	6.48	7.34	0.85
U__050_2	5.48	6.56	1.08	7.24	6.56	-0.68	6.97	6.99	0.02
U__150_1	6.01	5.74	-0.27	5.87	5.74	-0.14	4.79	5.77	0.97
U__150_2	6.42	7.38	0.96	6.28	5.74	-0.55	6.68	6.59	-0.09

TABLE II.2 (cont'd)

Average

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	6.37	5.83	-0.54
L__050_2	6.70	6.68	-0.01
L__150_1	6.85	6.06	-0.78
L__150_2	6.30	6.47	0.16
LC_050_1	6.33	6.45	0.13
LC_050_2	6.09	5.98	-0.12
LC_150_1	6.49	6.97	0.48
LC_150_2	6.18	6.70	0.52
U__050_1	6.26	6.36	0.10
U__050_2	6.56	6.70	0.14
U__150_1	5.56	5.75	0.19
U__150_2	6.46	6.57	0.11

TABLE II.3

PRONG 1990

Plant Count
[pl/12 m]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
l 50-1	72.0	60.0	-12.0	69.0	78.0	9.0	69.0	54.0	-15.0
l 50-2	57.0	66.0	9.0	78.0	84.0	6.0	87.0	69.0	-18.0
l150-1	61.5	60.0	-1.5	73.5	60.0	-13.5	93.0	81.0	-12.0
l150-2	64.5	75.0	10.5	60.0	66.0	6.0	84.0	72.0	-12.0
lc 50-1	69.0	69.0	0.0	63.0	66.0	3.0	78.0	78.0	0.0
lc 50-2	61.5	75.0	13.5	73.5	54.0	-19.5	67.5	69.0	1.5
lc150-1	75.0	75.0	0.0	73.5	72.0	-1.5	66.0	84.0	18.0
lc150-2	63.0	66.0	3.0	69.0	69.0	0.0	72.0	87.0	15.0
u 50-1	67.5	66.0	-1.5	67.5	63.0	-4.5	72.0	81.0	9.0
u 50-2	60.0	72.0	12.0	79.5	72.0	-7.5	76.5	78.0	1.5
u150-1	66.0	63.0	-3.0	64.5	63.0	-1.5	52.5	63.0	10.5
u150-2	70.5	81.0	10.5	69.0	63.0	-6.0	75.0	72.0	-3.0

TABLE II.3 (cont'd)

Averages

Treatm	A_Chk	Trmt	D_Trmt
l 50-1	70.00	64.00	-6.00
l 50-2	74.00	73.00	-1.00
l150-1	76.00	67.00	-9.00
l150-2	69.50	71.00	1.50
lc 50-1	70.00	71.00	1.00
lc 50-2	67.50	66.00	-1.50
lc150-1	71.50	77.00	5.50
lc150-2	68.00	74.00	6.00
u 50-1	69.00	70.00	1.00
u 50-2	72.00	74.00	2.00
u150-1	61.00	63.00	2.00
u150-2	71.50	72.00	0.50

TABLE II.4.

PRONG 1990
Full Plant

Biomass
[Kg/Ha]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
L__050_1	49922	28907	-21015	34172	37153	2981	47558	35066	-12493
L__050_2	34664	35705	1041	35945	45060	9115	40642	49642	9000
L__150_1	31432	43388	11956	47469	32951	-14518	57218	55234	-1984
L__150_2	31943	47541	15598	33607	29995	-3612	48939	52000	3061
LC_050_1	31280	51342	20061	35974	39071	3097	36679	63022	26342
LC_050_2	34768	38046	3279	51145	31623	-19522	45971	47546	1575
LC_150_1	53279	45628	-7650	42544	54361	11817	44081	47118	3037
LC_150_2	30858	36967	6109	28495	45246	16751	41671	57376	15705
U__050_1	38578	47546	8969	34538	37180	2642	43890	67500	23610
U__050_2	21876	34754	12878	38497	47213	8716	35077	50113	15036
U__150_1	35044	48197	13153	39426	44639	5213	37246	35942	-1304
U__150_2	42037	53484	11447	27530	43320	15790	38274	53538	15265

TABLE II.4. (cont'd)

Averages

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	43884	33709	-10176
L__050_2	37084	43469	6385
L__150_1	45373	43858	-1515
L__150_2	38163	43179	5016
LC_050_1	34645	51145	16500
LC_050_2	43961	39072	-4889
LC_150_1	46635	49036	2401
LC_150_2	33675	46530	12855
U__050_1	39002	50742	11740
U__050_2	31817	44027	12210
U__150_1	37239	42926	5687
U__150_2	35947	50114	14167

TABLE II.5.

PRONG 1990
Full Plant

Total N
[Kg/Ha]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
L__050_1	474	240	-234	335	457	122	518	249	-269
L__050_2	329	257	-72	352	446	94	443	263	-180
L__150_1	299	421	122	465	247	-218	624	536	-88
L__150_2	303	352	48	329	240	-89	533	556	23
LC_050_1	297	354	57	353	348	-5	400	271	-129
LC_050_2	330	365	35	501	319	-182	501	271	-230
LC_150_1	506	502	-4	417	554	138	480	565	85
LC_150_2	293	414	121	279	380	101	454	453	-1
U__050_1	366	399	33	338	245	-93	478	648	170
U__050_2	208	275	67	377	335	-42	382	326	-57
U__150_1	333	371	38	386	388	2	406	309	-97
U__150_2	399	519	119	270	386	116	417	525	107

TABLE II.5. (cont'd)

Averages

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	443	315	-127
L__050_2	375	322	-53
L__150_1	462	401	-61
L__150_2	389	383	-6
LC_050_1	350	324	-26
LC_050_2	444	319	-126
LC_150_1	468	541	73
LC_150_2	342	416	74
U__050_1	394	431	36
U__050_2	322	312	-11
U__150_1	375	356	-19
U__150_2	362	476	114

TABLE II.6.

PRONG 1990
Full Plant

Total P
[Kg/Ha]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
L__050_1	96	70	-27	74	133	58	95	44	-51
L__050_2	67	61	-6	78	103	25	81	35	-47
L__150_1	61	71	10	103	33	-70	114	105	-9
L__150_2	62	69	8	73	30	-43	98	82	-16
LC_050_1	60	78	17	78	79	0	73	40	-33
LC_050_2	67	70	3	111	61	-50	92	27	-65
LC_150_1	103	88	-15	92	111	19	88	72	-16
LC_150_2	60	79	20	62	48	-13	83	50	-33
U__050_1	74	72	-3	75	41	-34	88	86	-2
U__050_2	42	36	-6	84	42	-42	70	32	-38
U__150_1	68	44	-24	86	57	-28	74	42	-32
U__150_2	81	80	-1	60	38	-22	77	77	0

TABLE II.6. (cont'd)

Averages

Treatm	A_Chk	Trmt	D_Trmt
L__050_1	89	82	-6
L__050_2	75	66	-9
L__150_1	93	69	-23
L__150_2	77	61	-17
LC_050_1	71	65	-5
LC_050_2	90	53	-37
LC_150_1	94	90	-4
LC_150_2	68	59	-9
U__050_1	79	66	-13
U__050_2	65	37	-29
U__150_1	76	48	-28
U__150_2	72	65	-8

TABLE II.7.

PRONG 1990 YIELD Kg/ha 15.5 %

	Block I			Block II			Block III		
Trtm	A_Check	Trtm	D_Yield	A_Check	Trtm	D_Yield	A_Check	Trtm	D_Yield
L__050_1	5052	5330	277	5406	8113	2707	7777	7463	-314
L__050_2	4961	6820	1859	6649	7872	1223	7322	7310	-12
L__150_1	5362	7445	2082	5786	5808	23	7297	8557	1260
L__150_2	4850	6306	1456	7038	6954	-85	7634	9062	1428
LC_050_1	4166	5056	890	6093	5868	-224	7996	8631	635
LC_050_2	5252	5416	164	6175	6500	325	7871	8670	799
LC_150_1	4777	6437	1660	5988	6252	264	7795	7623	-172
LC_150_2	3990	6188	2198	5492	6494	1002	7397	7111	-286
U__050_1	5819	7692	1873	7040	7474	434	7655	9319	1663
U__050_2	5191	5795	604	6310	7343	1033	7652	6980	-672
U__150_1	5375	6764	1389	6750	7345	595	6825	8676	1851
U__150_2	5603	7043	1440	5899	6621	723	8045	8834	789

TABLE II.7. (cont'd)

Averages

Trtm	A_Check	Trtm	D_Yield
L__050_1	6079	6969	890
L__050_2	6310	7334	1023
L__150_1	6148	7270	1122
L__150_2	6507	7441	933
LC_050_1	6085	6519	434
LC_050_2	6432	6862	430
LC_150_1	6187	6771	584
LC_150_2	5626	6598	972
U__050_1	6838	8162	1323
U__050_2	6384	6706	322
U__150_1	6317	7595	1278
U__150_2	6516	7500	984

TABLE II.8.

PRONG 1990 [Number of Cobs]

	Block I			Block II			Block III		
Treatm	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt
L__050_1	52.0	51.0	-1.0	45.5	68.0	22.5	63.5	59.0	-4.5
L__050_2	46.0	67.0	21.0	53.0	61.0	8.0	66.0	68.0	2.0
L__150_1	49.5	58.0	8.5	53.5	52.0	-1.5	63.0	79.0	16.0
L__150_2	50.5	56.0	5.5	62.0	60.0	-2.0	67.5	73.0	5.5
LC_050_1	48.5	54.0	5.5	51.5	55.0	3.5	67.0	66.0	-1.0
LC_050_2	51.0	50.0	-1.0	55.0	46.0	-9.0	63.0	65.0	2.0
LC_150_1	52.0	59.0	7.0	54.5	53.0	-1.5	62.5	81.0	18.5
LC_150_2	43.5	53.0	9.5	51.0	49.0	-2.0	60.0	68.0	8.0
U__050_1	53.5	79.0	25.5	54.5	59.0	4.5	62.5	78.0	15.5
U__050_2	46.0	53.0	7.0	57.0	66.0	9.0	66.5	63.0	-3.5
U__150_1	53.0	55.0	2.0	62.0	61.0	-1.0	48.5	65.0	16.5
U__150_2	53.0	60.0	7.0	51.5	57.0	5.5	64.5	78.0	13.5

TABLE II.8. (cont'd)

Averages

Treatm	D_Chk	Trmt	D_Trmt
L__050_1	53.7	59.3	5.7
L__050_2	55.0	65.3	10.3
L__150_1	55.3	63.0	7.7
L__150_2	60.0	63.0	3.0
LC_050_1	55.7	58.3	2.7
LC_050_2	56.3	53.7	-2.7
LC_150_1	56.3	64.3	8.0
LC_150_2	51.5	56.7	5.2
U__050_1	56.8	72.0	15.2
U__050_2	56.5	60.7	4.2
U__150_1	54.5	60.3	5.8
U__150_2	56.3	65.0	8.7

TABLE II.9.

PRONG 1990

Soil P and K contents
[mg/Kg]

Sample B	#	0-15 cm P	0-15 cm K	15-60 cm P	15-60 cm K	Sample B	#	0-15 cm P	0-15 cm K	15-60 cm P	15-60 cm K
1	1	36	143	17	108	3	1	19	83	10	180
1	2	10	97	17	108	3	2	19	84	14	27
1	3	12	96	8	79	3	3	15	100	16	244
1	4	20	92	7	82	3	4	17	105	12	134
2	1	22	110	8	78						
2	2	18	105	10	37						
2	3	9	120	10	123						
2	4	7	54	9	325						
Avg		17	102	11	118			18	93	13	146
Std		9	24	4	82			2	10	2	79
CV		53	23	35	70			9	10	17	54

Fertilizer req., [kg/ha]

20	30

TABLE II.9. (cont'd)

Soil N Content

[mg N/Kg]

Sample B	Sample #	0-15 cm NH_4	0-15 cm NO_3	15-60 cm NH_4	15-60 cm NO_3	Sample B	Sample #	0-15 cm NH_4	0-15 cm NO_3	15-60 cm NH_4	15-60 cm NO_3
1	2	2.21	2.40	0.00	0.00	3	1	1.68	1.60	1.21	0.00
1	3	3.61	2.59	1.98	0.00	3	2	2.20	2.50	9.02	3.68
1	4	2.25	1.94	0.00	0.15	3	3	2.16	1.49	4.55	0.84
2	1	1.51	1.24	2.62	3.20	3	4	2.51	2.97	10.02	4.66
2	2	1.89	1.56	0.00	0.36						
2	3	1.24	1.36	1.78	0.00						
2	4	2.32	1.93	6.32	8.41						
Avg		1.88	1.63	1.59	1.52			2.14	2.14	6.20	2.30
Kg N/ha		3.80	9.89	3.21	9.20			4.33	13.00	12.56	13.94
Total N		26.11						43.83			

TABLE II.10 Analysis of variance for effects of treatments on yield at Prong site 1990 (28% N vs. Urea)

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	29389765.87	2099268.99	3.29	0.0068
Error	21	13381944.13	637235.43		
Corrected Total	35	42771710.00			

R-Square	C.V.	Root MSE	TRTM Mean
0.687131	11.17452	798.2703	7143.66667

TABLE II.10. (cont'd)

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	21249930.67	10624965.33	16.67	0.0001
CHECK	1	2709866.36	2709866.36	4.25	0.0518
FERT	2	2372829.81	1186414.91	1.86	0.1801
DOSE	1	226923.82	226923.82	0.36	0.5571
FERT*DOSE	2	5064.68	2532.34	0.00	0.9960
TIME	1	200819.91	200819.91	0.32	0.5805
FERT*TIME	2	1503693.26	751846.63	1.18	0.3269
DOSE*TIME	1	120465.67	120465.67	0.19	0.6681
FERT*DOSE*TIME	2	1000171.69	500085.85	0.78	0.4692

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	1881907.058	940953.529	1.48	0.2512
CHECK	1	229673.874	229673.874	0.36	0.5547
FERT	2	2264970.694	1132485.347	1.78	0.1936
DOSE	1	204439.335	204439.335	0.32	0.5771
FERT*DOSE	2	6031.618	3015.809	0.00	0.9953
TIME	1	200819.906	200819.906	0.32	0.5805
FERT*TIME	2	1500704.015	750352.008	1.18	0.3276
DOSE*TIME	1	120465.674	120465.674	0.19	0.6681
FERT*DOSE*TIME	2	1000171.692	500085.846	0.78	0.4692

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	29389765.87	2099268.99	3.29	0.0068
Error	21	13381944.13	637235.43		
Corrected Total	35	42771710.00			

R-Square	C.V.	Root MSE	TRTM Mean
0.687131	11.17452	798.2703	7143.66667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	21249930.67	10624965.33	16.67	0.0001
CHECK	1	2709866.36	2709866.36	4.25	0.0518
FERT	2	2372829.81	1186414.91	1.86	0.1801
DOSE	1	226923.82	226923.82	0.36	0.5571
FERT*DOSE	2	5064.68	2532.34	0.00	0.9960
TIME	1	200819.91	200819.91	0.32	0.5805
FERT*TIME	2	1503693.26	751846.63	1.18	0.3269
DOSE*TIME	1	120465.67	120465.67	0.19	0.6681
FERT*DOSE*TIME	2	1000171.69	500085.85	0.78	0.4692

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	1881907.058	940953.529	1.48	0.2512
CHECK	1	229673.874	229673.874	0.36	0.5547
FERT	2	2264970.694	1132485.347	1.78	0.1936
DOSE	1	204439.335	204439.335	0.32	0.5771
FERT*DOSE	2	6031.618	3015.809	0.00	0.9953
TIME	1	200819.906	200819.906	0.32	0.5805
FERT*TIME	2	1500704.015	750352.008	1.18	0.3276
DOSE*TIME	1	120465.674	120465.674	0.19	0.6681
FERT*DOSE*TIME	2	1000171.692	500085.846	0.78	0.4692

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 637235.4

Number of Means	2	3
Critical Range	676.9	710.9

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	8186.3	12	3
B	6887.0	12	2
B			
B	6357.7	12	1

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 637235.4

Number of Means	2	3
Critical Range	676.9	710.9

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	7490.5	12	3
A			
B A	7253.3	12	1
B			
B	6687.2	12	2

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 21 MSE= 637235.4

Number of Means	2	3
Critical Range	560.5	590.5

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	8186.3	12	3
B	6887.0	12	2
B			
B	6357.7	12	1

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 21 MSE= 637235.4

Number of Means	2	3
Critical Range	560.5	590.5

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	7490.5	12	3
A			
A	7253.3	12	1
B	6687.2	12	2

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 637235.4

Number of Means 2
Critical Range 552.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	7195.6	18	2
A			
A	7091.8	18	1

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 637235.4

Number of Means 2
Critical Range 552.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	7214.1	18	1
A			
A	7073.3	18	2

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6
FXT	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	28269128.51	2569920.77	4.25	0.0015
Error	24	14502581.49	604274.23		
Corrected Total	35	42771710.00			

R-Square	C.V.	Root MSE	TRTM Mean
0.660931	10.88168	777.3508	7143.66667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	21249930.67	10624965.33	17.58	0.0001
CHECK	1	2709866.36	2709866.36	4.48	0.0448
FXD	5	2604818.31	520963.66	0.86	0.5206
FXT	3	1704513.17	568171.06	0.94	0.4367

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	1467449.735	733724.868	1.21	0.3145
CHECK	1	724866.174	724866.174	1.20	0.2843
FXD	3	210616.280	70205.427	0.12	0.9497
FXT	3	1704513.166	568171.055	0.94	0.4367

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 24 MSE= 604274.2

Number of Means	2	3	4	5	6
Critical Range	767.5	809.1	836.3	851.5	864.6

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	7547.2	6	6
A			
A	7433.8	6	5
A			
A	7355.3	6	2
A			
A	7151.3	6	1
A			
A	6690.2	6	3
A			
A	6684.2	6	4

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 24 MSE= 604274.2

Number of Means	2	3	4	5	6
Critical Range	767.5	809.1	836.3	851.5	864.6

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXT
	A	7878.3	6	5
	A			
B	A	7387.3	6	2
B	A			
B	A	7119.3	6	1
B	A			
B	A	7102.7	6	6
B				
B		6729.8	6	4
B				
B		6644.5	6	3

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

xxx

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	29160092.00	2243084.00	3.63	0.0038
Error	22	13611618.00	618709.91		
Corrected Total	35	42771710.00			

R-Square	C.V.	Root MSE	TRTM Mean
0.681761	11.01089	786.5812	7143.66667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	21249930.67	10624965.33	17.17	0.0001
FERT	2	4088548.67	2044274.33	3.30	0.0556
DOSE	1	96928.44	96928.44	0.16	0.6961
FERT*DOSE	2	66560.89	33280.44	0.05	0.9478
TIME	1	178365.44	178365.44	0.29	0.5967
FERT*TIME	2	1863928.22	931964.11	1.51	0.2437
DOSE*TIME	1	105192.11	105192.11	0.17	0.6841
FERT*DOSE*TIME	2	1510637.56	755318.78	1.22	0.3142

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	21249930.67	10624965.33	17.17	0.0001
FERT	2	4088548.67	2044274.33	3.30	0.0556
DOSE	1	96928.44	96928.44	0.16	0.6961
FERT*DOSE	2	66560.89	33280.44	0.05	0.9478
TIME	1	178365.44	178365.44	0.29	0.5967
FERT*TIME	2	1863928.22	931964.11	1.51	0.2437
DOSE*TIME	1	105192.11	105192.11	0.17	0.6841
FERT*DOSE*TIME	2	1510637.56	755318.78	1.22	0.3142

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 22 MSE= 618709.9

Number of Means	2	3
Critical Range	551.1	580.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	8186.3	12	3
B	6887.0	12	2
B			
B	6357.7	12	1

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 22 MSE= 618709.9

Number of Means	2	3
Critical Range	551.1	580.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	7490.5	12	3
A			
A	7253.3	12	1
B	6687.2	12	2

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 22 MSE= 618709.9

Number of Means 2
Critical Range 450.0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	7195.6	18	2
A			
A	7091.8	18	1

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 22 MSE= 618709.9

Number of Means 2
Critical Range 450.0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	7214.1	18	1
A			
A	7073.3	18	2

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6
FXT	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	27544262.33	2754426.23	4.52	0.0011
Error	25	15227447.67	609097.91		
Corrected Total	35	42771710.00			

R-Square	C.V.	Root MSE	TRTM Mean
0.643983	10.92502	780.4472	7143.66667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	21249930.67	10624965.33	17.44	0.0001
FXD	5	4252038.00	850407.60	1.40	0.2597
FXT	3	2042293.67	680764.56	1.12	0.3607

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	21249930.67	10624965.33	17.44	0.0001
FXD	3	163489.33	54496.44	0.09	0.9652
FXT	3	2042293.67	680764.56	1.12	0.3607

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 25 MSE= 609097.9

Number of Means	2	3	4	5	6
Critical Range	769.4	811.2	838.7	853.9	867.3

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	7547.2	6	6
A			
A	7433.8	6	5
A			
A	7355.3	6	2
A			
A	7151.3	6	1
A			
A	6690.2	6	3
A			
A	6684.2	6	4

Nitrogen Type Experiment - PRONG SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 25 MSE= 609097.9

Number of Means	2	3	4	5	6
Critical Range	769.4	811.2	838.7	853.9	867.3

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXT
	A	7878.3	6	5
	A			
B	A	7387.3	6	2
B	A			
B	A	7119.3	6	1
B	A			
B	A	7102.7	6	6
B				
B		6729.8	6	4
B				
B		6644.5	6	3

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure
Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	2036.528286	145.466306	2.97	0.0119
Error	21	1027.110603	48.910029		
Corrected Total	35	3063.638889			

R-Square	C.V.	Root MSE	TRTM Mean
0.664742	11.31544	6.993571	61.8055556

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	1286.222222	643.111111	13.15	0.0002
CHECK	1	22.535906	22.535906	0.46	0.5047
FERT	2	233.839911	116.919956	2.39	0.1161
DOSE	1	2.250000	2.250000	0.05	0.8322
FERT*DOSE	2	103.034456	51.517228	1.05	0.3665
TIME	1	45.614302	45.614302	0.93	0.3452
FERT*TIME	2	118.274680	59.137340	1.21	0.3184
DOSE*TIME	1	12.250000	12.250000	0.25	0.6220
FERT*DOSE*TIME	2	212.506809	106.253404	2.17	0.1388

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	533.1488444	266.5744222	5.45	0.0124
CHECK	1	0.0005081	0.0005081	0.00	0.9975
FERT	2	232.2328389	116.1164195	2.37	0.1176
DOSE	1	2.2500000	2.2500000	0.05	0.8322
FERT*DOSE	2	100.7621359	50.3810680	1.03	0.3743
TIME	1	45.6143018	45.6143018	0.93	0.3452
FERT*TIME	2	118.2746797	59.1373398	1.21	0.3184
DOSE*TIME	1	12.2500000	12.2500000	0.25	0.6220
FERT*DOSE*TIME	2	212.5068085	106.2534043	2.17	0.1388

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 48.91003

Number of Means	2	3
Critical Range	5.930	6.228

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	70.250	12	3
B	57.917	12	1
B			
B	57.250	12	2

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 48.91003

Number of Means	2	3
Critical Range	5.930	6.228

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	64.500	12	3
A			
B A	62.667	12	1
B			
B	58.250	12	2

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 48.91003

Number of Means 2
Critical Range 4.842

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	62.056	18	2
A			
A	61.556	18	1

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 48.91003

Number of Means 2
Critical Range 4.842

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	62.889	18	1
A			
A	60.722	18	2

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	1636.361111	233.765873	4.59	0.0016
Error	28	1427.277778	50.974206		
Corrected Total	35	3063.638889			

R-Square	C.V.	Root MSE	TRTM Mean
0.534123	11.55175	7.139622	61.8055556

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	1286.222222	643.111111	12.62	0.0001
FXD	5	350.138889	70.027778	1.37	0.2640

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	1286.222222	643.111111	12.62	0.0001
FXD	5	350.138889	70.027778	1.37	0.2640

Nitrogen Type Experiment - PRONG SITE - COB NUMBER
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 28 MSE= 50.97421

Number of Means	2	3	4	5	6
Critical Range	8.438	8.867	9.162	9.347	9.497

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXD
	A	66.333	6	5
	A			
B	A	63.000	6	2
B	A			
B	A	62.667	6	6
B	A			
B	A	62.333	6	1
B	A			
B	A	60.500	6	4
B				
B		56.000	6	3

Nitrogen Type Experiment - PRONG SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	965.4950894	68.9639350	0.96	0.5181
Error	21	1505.5049106	71.6907100		
Corrected Total	35	2471.0000000			

R-Square	C.V.	Root MSE	TRTM Mean
0.390731	12.06704	8.467037	70.1666667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	278.0000000	139.0000000	1.94	0.1688
CHECK	1	163.2831569	163.2831569	2.28	0.1462
FERT	2	107.0510247	53.5255124	0.75	0.4861
DOSE	1	14.7314251	14.7314251	0.21	0.6550
FERT*DOSE	2	149.4047403	74.7023702	1.04	0.3703
TIME	1	68.3410846	68.3410846	0.95	0.3400
FERT*TIME	2	167.8827161	83.9413581	1.17	0.3295
DOSE*TIME	1	2.2048900	2.2048900	0.03	0.8625
FERT*DOSE*TIME	2	14.5960517	7.2980258	0.10	0.9037

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	171.9581379	85.9790689	1.20	0.3212
CHECK	1	70.4950894	70.4950894	0.98	0.3327
FERT	2	106.3680585	53.1840292	0.74	0.4883
DOSE	1	13.7511368	13.7511368	0.19	0.6659
FERT*DOSE	2	156.9620121	78.4810060	1.09	0.3530
TIME	1	68.3410846	68.3410846	0.95	0.3400
FERT*TIME	2	167.6017452	83.8008726	1.17	0.3301
DOSE*TIME	1	2.2048900	2.2048900	0.03	0.8625
FERT*DOSE*TIME	2	14.5960517	7.2980258	0.10	0.9037

Nitrogen Type Experiment - PRONG SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 71.69071

Number of Means	2	3
Critical Range	7.180	7.541

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	74.000	12	3
A			
A	69.000	12	1
A			
A	67.500	12	2

Nitrogen Type Experiment - PRONG SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 71.69071

Number of Means	2	3
Critical Range	7.180	7.541

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	72.000	12	2
A			
A	69.750	12	3
A			
A	68.750	12	1

Nitrogen Type Experiment - PRONG SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 71.69071

Number of Means 2
Critical Range 5.862

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	70.667	18	2
A			
A	69.667	18	1

Nitrogen Type Experiment - PRONG SITE - PLANT NUMBER
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 71.69071

Number of Means 2
Critical Range 5.862

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	71.667	18	2
A			
A	68.667	18	1

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	1653932328	118138023	1.91	0.0875
Error	21	1299390634	61875744		
Corrected Total	35	2953322962			

R-Square	C.V.	Root MSE	TRTM Mean
0.560024	17.55161	7866.114	44817.0556

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	750954942.7	375477471.4	6.07	0.0083
CHECK	1	6412483.8	6412483.8	0.10	0.7507
FERT	2	251707182.9	125853591.5	2.03	0.1558
DOSE	1	44317166.8	44317166.8	0.72	0.4069
FERT*DOSE	2	51160154.1	25580077.0	0.41	0.6667
TIME	1	5819930.5	5819930.5	0.09	0.7621
FERT*TIME	2	220527327.3	110263663.7	1.78	0.1928
DOSE*TIME	1	52141417.7	52141417.7	0.84	0.3691
FERT*DOSE*TIME	2	270891721.8	135445860.9	2.19	0.1369

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	470596249.1	235298124.6	3.80	0.0390
CHECK	1	33086025.6	33086025.6	0.53	0.4727
FERT	2	250851111.4	125425555.7	2.03	0.1567
DOSE	1	42338378.8	42338378.8	0.68	0.4174
FERT*DOSE	2	51095297.3	25547648.7	0.41	0.6670
TIME	1	5819930.5	5819930.5	0.09	0.7621
FERT*TIME	2	228373030.6	114186515.3	1.85	0.1827
DOSE*TIME	1	52141417.7	52141417.7	0.84	0.3691
FERT*DOSE*TIME	2	270891721.8	135445860.9	2.19	0.1369

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61875744

Number of Means 2 3
Critical Range 6670 7005

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	51175	12	3
B	42625	12	1
B			
B	40651	12	2

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61875744

Number of Means 2 3
Critical Range 6670 7005

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	46952	12	3
A			
A	46446	12	2
A			
A	41054	12	1

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61875744

Number of Means 2
Critical Range 5446

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	45940	18	2
A			
A	43694	18	1

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 61875744

Number of Means 2
Critical Range 5446

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	45236	18	1
A			
A	44398	18	2

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	1104045891	157720842	2.39	0.0477
Error	28	1849277071	66045610		
Corrected Total	35	2953322962			

R-Square	C.V.	Root MSE	TRTM Mean
0.373832	18.13338	8126.845	44817.0556

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	750954942.7	375477471.4	5.69	0.0085
FXD	5	353090948.2	70618189.6	1.07	0.3983

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	750954942.7	375477471.4	5.69	0.0085
FXD	5	353090948.2	70618189.6	1.07	0.3983

Nitrogen Type Experiment - PRONG SITE - BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 28 MSE= 66045610

Number of Means	2	3	4	5	6
Critical Range	9605	10094	10429	10639	10810

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	47783	6	4
A			
A	47384	6	5
A			
A	46520	6	6
A			
A	45108	6	3
A			
A	43518	6	2
A			
A	38589	6	1

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	201721.8027	14408.7002	1.28	0.2955
Error	21	236118.0862	11243.7184		
Corrected Total	35	437839.8889			

R-Square	C.V.	Root MSE	TRTM Mean
0.460720	27.68976	106.0364	382.944444

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	18375.38889	9187.69444	0.82	0.4553
CHECK	1	19329.69599	19329.69599	1.72	0.2040
FERT	2	24335.90442	12167.95221	1.08	0.3570
DOSE	1	68021.53556	68021.53556	6.05	0.0227
FERT*DOSE	2	20880.56121	10440.28061	0.93	0.4108
TIME	1	503.41087	503.41087	0.04	0.8345
FERT*TIME	2	12357.65296	6178.82648	0.55	0.5853
DOSE*TIME	1	7071.34132	7071.34132	0.63	0.4366
FERT*DOSE*TIME	2	30846.31147	15423.15574	1.37	0.2755

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3047.35744	1523.67872	0.14	0.8740
CHECK	1	6658.52492	6658.52492	0.59	0.4501
FERT	2	23102.24354	11551.12177	1.03	0.3753
DOSE	1	67445.10458	67445.10458	6.00	0.0232
FERT*DOSE	2	21027.03359	10513.51679	0.94	0.4083
TIME	1	503.41087	503.41087	0.04	0.8345
FERT*TIME	2	13039.67222	6519.83611	0.58	0.5687
DOSE*TIME	1	7071.34132	7071.34132	0.63	0.4366
FERT*DOSE*TIME	2	30846.31147	15423.15574	1.37	0.2755

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 11243.72

Number of Means	2	3
Critical Range	89.91	94.44

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	414.33	12	3
A			
A	372.42	12	1
A			
A	362.08	12	2

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 11243.72

Number of Means	2	3
Critical Range	89.91	94.44

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	399.67	12	2
A			
A	393.83	12	3
A			
A	355.33	12	1

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 11243.72

Number of Means 2
Critical Range 73.41

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	428.78	18	2
B	337.11	18	1

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 11243.72

Number of Means 2
Critical Range 73.41

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	394.67	18	1
A			
A	371.22	18	2

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	128143.9444	18306.2778	1.66	0.1612
Error	28	309695.9444	11060.5694		
Corrected Total	35	437839.8889			

R-Square	C.V.	Root MSE	TRTM Mean
0.292673	27.46332	105.1692	382.944444

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	18375.3889	9187.6944	0.83	0.4462
FXD	5	109768.5556	21953.7111	1.98	0.1119

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	18375.3889	9187.6944	0.83	0.4462
FXD	5	109768.5556	21953.7111	1.98	0.1119

Nitrogen Type Experiment - PRONG SITE - TOTAL N
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 28 MSE= 11060.57

Number of Means	2	3	4	5	6
Critical Range	124.3	130.6	135.0	137.7	139.9

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	FXD
	A	478.00	6	4
	A			
B	A	416.33	6	6
B	A			
B	A	392.00	6	2
B	A			
B	A	371.33	6	5
B				
B		321.33	6	3
B				
B		318.67	6	1

Nitrogen Type Experiment - PRONG SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	3	1 2 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 36

NOTE: Due to missing values, only 35 observations can be used in this analysis.

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	100122.3640	7151.5974	23.57	0.0001
Error	20	6069.6360	303.4818		
Corrected Total	34	106192.0000			

R-Square	C.V.	Root MSE	TRTM Mean
0.942843	19.35637	17.42073	90.0000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	93718.03030	46859.01515	154.40	0.0001
CHECK	1	3022.74658	3022.74658	9.96	0.0050
FERT	2	875.45049	437.72525	1.44	0.2599
DOSE	1	68.04728	68.04728	0.22	0.6410
FERT*DOSE	2	388.74195	194.37098	0.64	0.5375
TIME	1	278.27191	278.27191	0.92	0.3497
FERT*TIME	2	402.90699	201.45349	0.66	0.5259
DOSE*TIME	1	392.81577	392.81577	1.29	0.2687
FERT*DOSE*TIME	2	975.35276	487.67638	1.61	0.2253

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	2938.563871	1469.281935	4.84	0.0193
CHECK	1	1663.470099	1663.470099	5.48	0.0297
FERT	2	825.779092	412.889546	1.36	0.2793
DOSE	1	76.678970	76.678970	0.25	0.6207
FERT*DOSE	2	373.474356	186.737178	0.62	0.5504
TIME	1	278.271913	278.271913	0.92	0.3497
FERT*TIME	2	352.150436	176.075218	0.58	0.5689
DOSE*TIME	1	392.815772	392.815772	1.29	0.2687
FERT*DOSE*TIME	2	975.352759	487.676379	1.61	0.2253

Nitrogen Type Experiment - PRONG SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 20 MSE= 303.4818
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 11.64706

Number of Means	2	3
Critical Range	12.44	13.11

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	165.818	11	3
B	63.167	12	2
C	47.333	12	1

Nitrogen Type Experiment - PRONG SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 20 MSE= 303.4818
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 11.64706

Number of Means	2	3
Critical Range	12.44	13.11

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	98.167	12	3
A			
B A	89.000	12	2
B			
B	82.182	11	1

Nitrogen Type Experiment - PRONG SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 20 MSE= 303.4818
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 17.48571

Number of Means 2
Critical Range 10.16

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	90.778	18	1
A			
A	89.176	17	2

Nitrogen Type Experiment - PRONG SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 20 MSE= 303.4818
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 17.48571

Number of Means 2
Critical Range 10.16

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	92.824	17	1
A			
A	87.333	18	2

Nitrogen Type Experiment - PRONG SITE - 6 LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	6	1 2 3 4 5 6

Number of observations in data set = 36

NOTE: Due to missing values, only 35 observations can be used in this analysis.

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	98073.01661	12[illegible]9.12708	39.26	0.0001
Error	26	8118.98339	312.26859		
Corrected Total	34	106192.00000			

R-Square	C.V.	Root MSE	TRTM Mean
0.923544	19.63458	17.67112	90.0000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	93718.03030	46859.01515	150.06	0.0001
CHECK	1	3022.74658	3022.74658	9.68	0.0045
FXD	5	1332.23972	266.44794	0.85	0.5251

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	2507.465684	1253.732842	4.01	0.0302
CHECK	1	3452.790415	3452.790415	11.06	0.0026
FXD	5	1332.239723	266.447945	0.85	0.5251

Nitrogen Type Experiment - PRONG SITE - 6 LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 26 MSE= 312.2686
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 5.806452

Number of Means	2	3	4	5	6
Critical Range	17.68	18.65	19.28	19.63	19.95

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	102.33	6	6
A			
A	94.00	6	5
A			
B A	90.00	6	1
B A			
B A	89.67	6	4
B A			
B A	88.33	6	3
B			
B	72.80	5	2

APPENDIX III

PRONG SITE 1990

Urea Placement Experiment

Measurements and Statistical Analysis

TABLE III.1.

UREA 90
6 Leaf Stage

Biomass
[kg/ha]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
2_04_p	45	96	51	54	83	30	78	40	-38
2_06_p	43	56	14	48	38	-10	102	132	30
2_10_p	30	68	38	52	90	38	125	124	-1
2_10_s	37	43	6	45	33	-12	82	68	-14
6_04_p	33	65	32	46	83	37	151	156	4
6_06_p	44	45	1	30	81	51	93	189	95
6_10_p	45	46	0	18	39	21	106	106	-0
6_10_s	34	28	-6	40	50	10	150	94	-56

Averages

Treatm	A_Chk	Trmt	D_Trmt
2_04_p	59	73	14
2_06_p	64	75	11
2_10_p	69	94	25
2_10_s	54	48	-6
6_04_p	77	101	25
6_06_p	56	105	49
6_10_p	56	63	7
6_10_s	75	57	-17

TABLE III.2.

UREA 90 Plant Density

[pl/m2]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
2_04_p	5.80	5.83	0.03	5.60	5.46	-0.14	5.42	4.62	-0.80
2_06_p	5.73	5.65	-0.09	5.05	4.64	-0.41	5.64	6.79	1.16
2_10_p	7.22	7.02	-0.20	6.42	6.01	-0.41	6.16	5.65	-0.52
2_10_s	6.67	5.79	-0.88	6.01	5.74	-0.27	6.01	5.71	-0.31
6_04_p	5.19	6.59	1.40	5.87	6.28	0.41	6.58	6.39	-0.19
6_06_p	5.56	5.85	0.29	4.51	6.28	1.78	5.71	7.61	1.90
6_10_p	5.81	5.43	-0.38	4.37	4.92	0.55	6.67	6.51	-0.16
6_10_s	5.14	5.43	0.29	5.87	7.10	1.23	6.50	5.04	-1.46

Averages

Treatm	A_Chk	Trmt	D_Trmt
2_04_p	5.61	5.31	-0.30
2_06_p	5.48	5.69	0.22
2_10_p	6.60	6.23	-0.38
2_10_s	6.23	5.74	-0.49
6_04_p	5.88	6.42	0.54
6_06_p	5.26	6.58	1.32
6_10_p	5.62	5.62	0.00
6_10_s	5.84	5.86	0.02

TABLE III.3.

UREA 90

Plant Count
[pl/12 m]

	Block I			Block II			Block III		
Treatm	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt
2_04_p	63.0	63.0	0.0	61.5	60.0	-1.5	58.5	51.0	-7.5
2_06_p	63.0	63.0	0.0	55.5	51.0	-4.5	61.5	75.0	13.5
2_10_p	78.0	75.0	-3.0	70.5	66.0	-4.5	66.0	63.0	-3.0
2_10_s	72.0	66.0	-6.0	66.0	63.0	-3.0	64.5	63.0	-1.5
6_04_p	57.0	72.0	15.0	64.5	69.0	4.5	75.0	69.0	-6.0
6_06_p	60.0	66.0	6.0	49.5	69.0	19.5	63.0	84.0	21.0
6_10_p	64.5	60.0	-4.5	48.0	54.0	6.0	72.0	75.0	3.0
6_10_s	55.5	60.0	4.5	64.5	78.0	13.5	72.0	69.0	-3.0

Averages

Treatm	D_Chk	Trmt	D_Trmt
2_04_p	61.0	58.0	-3.0
2_06_p	60.0	63.0	3.0
2_10_p	71.5	68.0	-3.5
2_10_s	67.5	64.0	-3.5
6_04_p	65.5	70.0	4.5
6_06_p	57.5	73.0	15.5
6_10_p	61.5	63.0	1.5
6_10_s	64.0	69.0	5.0

TABLE III.4.

UREA 90 Biomass
Full Plant [kg/ha]

	Block I			Block II			Block III		
Treatm	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt	A_Chk	Trmt	D_Trmt
2_04_p	27690	39842	12152	25258	45847	20589	37710	36217	-1492
2_06_p	22385	34831	12445	23724	30656	6932	31666	52106	20440
2_10_p	45139	47963	2825	33634	40213	6579	44376	50468	6092
2_10_s	35617	35489	-127	33447	38557	5111	42146	48734	6587
6_04_p	16893	52813	35920	19940	42104	22164	36513	58011	21498
6_06_p	23379	41484	18105	27511	42230	14719	28684	48163	19479
6_10_p	23246	24620	1374	30033	35902	5869	46842	32487	-14355
6_10_s	15158	19402	4245	22642	38787	16145	42606	28750	-13856

Averages

Treatm	A_Chk	Trmt	D_Trmt
2_04_p	30219	40635	10416
2_06_p	25925	39197	13272
2_10_p	41050	46215	5165
2_10_s	37070	40927	3857
6_04_p	24449	50976	26527
6_06_p	26524	43959	17434
6_10_p	33373	31003	-2371
6_10_s	26802	28980	2178

TABLE III.5.

UREA 90

[Kg/ha]

YIELD 15.5 %

	Block I			Block II			Block III		
Trtm	A_Check	Trtm	D_Yield	A_Check	Trtm	D_Yield	A_Check	Trtm	D_Yield
2_04_p	4023	7213	3190	4703	6904	2201	6953	8451	1497
2_06_p	2301	5368	3067	4367	6591	2224	7929	8439	510
2_10_p	7285	6597	-688	5303	7420	2118	8429	8779	350
2_10_s	5954	5361	-594	5346	5183	-162	5982	6986	1004
6_04_p	2929	4981	2052	5160	6916	1755	10967	8021	-2947
6_06_p	3228	5402	2174	4345	7252	2907	7024	9224	2199
6_10_p	2918	6624	3706	3828	6662	2834	6721	9461	2740
6_10_s	2731	1745	-985	4726	3593	-1133	9746	7698	-2048

Averages

Trtm	A_Check	Trtm	D_Yield
2_04_p	5227	7523	2296
2_06_p	4866	6799	1934
2_10_p	7006	7599	593
2_10_s	5761	5843	83
6_04_p	6352	6639	287
6_06_p	4866	7293	2427
6_10_p	4489	7582	3093
6_10_s	5734	4346	-1389

TABLE III.6.

UREA 90 [Number of Cobs]

	Block I			Block I			Block I		
Treatm	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt	D_Chk	Trmt	D_Trmt
2_04_p	50.0	65.0	15.0	53.5	51.0	-2.5	61.5	67.0	5.5
2_06_p	38.0	45.0	7.0	48.5	55.7	7.3	65.5	73.0	7.5
2_10_p	58.0	54.0	-4.0	50.5	74.0	23.5	64.5	77.0	12.5
2_10_s	53.5	53.0	-0.5	56.0	47.0	-9.0	57.5	63.0	5.5
6_04_p	38.5	55.0	16.5	53.0	62.0	9.0	71.0	55.0	-16.0
6_06_p	43.5	49.0	5.5	44.0	62.0	18.0	64.0	79.0	15.0
6_10_p	42.5	55.0	12.5	39.0	55.0	16.0	63.5	80.0	16.5
6_10_s	34.5	44.0	9.5	51.0	56.0	5.0	67.5	62.0	-5.5

Averages

Treatm	D_Chk	Trmt	D_Trmt
2_04_p	55.0	61.0	6.0
2_06_p	50.7	57.9	9.7
2_10_p	57.7	68.3	10.7
2_10_s	55.7	54.3	-1.3
6_04_p	54.2	57.3	3.2
6_06_p	50.5	63.3	12.8
6_10_p	48.3	63.3	15.0
6_10_s	51.0	54.0	3.0

TABLE III.7.

PRONG 90

Soil P and K contents
[mg/Kg]

Sample B	#	0-15 cm P	0-15 cm K	15-60 cm P	15-60 cm K	Sample B	#	0-15 cm P	0-15 cm K	15-60 cm P	15-60 cm K
1	1	36	143	17	108	3	1	19	83	10	180
1	2	10	97	17	108	3	2	19	84	14	27
1	3	12	96	8	79	3	3	15	100	16	244
1	4	20	92	7	82	3	4	17	105	12	134
2	1	22	110	8	78						
2	2	18	105	10	37						
2	3	9	120	10	123						
2	4	7	54	9	325						
Avg		17	102	11	118			18	93	13	146
Std		9	24	4	82			2	10	2	79
CV		53	23	35	70			9	10	17	54

Fertilizer req., [kg/ha]

20	30

TABLE III.7. (cont'd)

Soil N Content

[mg N/Kg]

Sample B	#	0-15 cm NH4	0-15 cm NO3	15-60 cm NH4	15-60 cm NO3	Sample B	#	0-15 cm NH4	0-15 cm NO3	15-60 cm NH4	15-60 cm NO3
1	2	2.21	2.40	0.00	0.00	3	1	1.68	1.60	1.21	0.00
1	3	3.61	2.59	1.98	0.00	3	2	2.20	2.50	9.02	3.68
1	4	2.25	1.94	0.00	0.15	3	3	2.16	1.49	4.55	0.84
2	1	1.51	1.24	2.62	3.20	3	4	2.51	2.97	10.02	4.66
2	2	1.89	1.56	0.00	0.36						
2	3	1.24	1.36	1.78	0.00						
2	4	2.32	1.93	6.32	8.41						
Avg		1.88	1.63	1.59	1.52			2.14	2.14	6.20	2.30
Kg N/ha		3.80	9.89	3.21	9.20			4.33	13.00	12.56	13.94
Total N		26.11						43.83			

TABLE III.8. Analysis of variance of treatment effects on yield for Urea placement (Prong 1990)

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DEPTH	2	2 6
WIDTH	3	4 6 10
TIME	2	1 2

Number of observations in data set = 24

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	66447810.43	6644781.04	12.90	0.0001
Error	13	6698808.53	515292.96		
Corrected Total	23	73146618.96			

R-Square	C.V.	Root MSE	TRTM Mean
0.908419	10.70929	717.8391	6702.95833

TABLE III.8. (cont'd)

TABLE III.9. Analysis of variance of treatment effects on yield for Urea Placement (Prong 1990)

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DEPTH	2	2 6
WIDTH	3	4 6 10

Number of observations in data set = 18

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	25406737.76	3175842.22	9.13	0.0016
Error	9	3129994.74	347777.19		
Corrected Total	17	28536732.50			

R-Square	C.V.	Root MSE	TRTM Mean
0.890317	8.146330	589.7264	7239.16667

TABLE III.9. (cont'd)

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	22557033.33	11278516.67	32.43	0.0001
CHECK	1	57900.14	57900.14	0.17	0.6928
DEPTH	1	61724.85	61724.85	0.18	0.6834
WIDTH	2	1077677.19	538838.59	1.55	0.2641
DEPTH*WIDTH	2	1652402.24	826201.12	2.38	0.1484

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3601017.987	1800508.994	5.18	0.0319
CHECK	1	199229.928	199229.928	0.57	0.4685
DEPTH	1	78292.153	78292.153	0.23	0.6465
WIDTH	2	1077677.189	538838.594	1.55	0.2641
DEPTH*WIDTH	2	1652402.243	826201.122	2.38	0.1484

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DEPTH	2	2 6
WIDTH	3	4 6 10
TIME	2	1 2

Number of observations in data set = 24

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	66447810.43	6644781.04	12.90	0.0001
Error	13	6698808.53	515292.96		
Corrected Total	23	73146618.96			

R-Square	C.V.	Root MSE	TRTM Mean
0.908419	10.70929	717.8391	6702.95833

Urea Placement Experiment - PRONG-UREA SITE - YIELD (cont'd)

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	37112340.33	18556170.17	36.01	0.0001
CHECK	1	711638.23	711638.23	1.38	0.2610
DEPTH	1	1133520.34	1133520.34	2.20	0.1619
WIDTH	2	3642211.92	1821105.96	3.53	0.0595
DEPTH*WIDTH	2	1935406.02	967703.01	1.88	0.1921
TIME	1	18692985.57	18692985.57	36.28	0.0001
DEPTH*TIME	1	3219708.01	3219708.01	6.25	0.0266
WIDTH*TIME	0	0.00	.	.	.
DEPTH*WIDTH*TIME	0	0.00	.	.	.

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3847434.01	1923717.01	3.73	0.0523
CHECK	1	2617594.47	2617594.47	5.08	0.0421
DEPTH	1	1036025.71	1036025.71	2.01	0.1797
WIDTH	2	864782.55	432391.28	0.84	0.4542
DEPTH*WIDTH	2	2834227.52	1417113.76	2.75	0.1009
TIME	1	18692985.57	18692985.57	36.28	0.0001
DEPTH*TIME	1	3219708.01	3219708.01	6.25	0.0266
WIDTH*TIME	0	0.00	.	.	.
DEPTH*WIDTH*TIME	0	0.00	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 515293

Number of Means	2	3
Critical Range	773.9	811.2

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	8382.4	8	3
B	6315.1	8	2
C	5411.4	8	1

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 515293

Number of Means	2
Critical Range	631.9

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DEPTH
A	6941.0	12	2
A			
A	6464.9	12	6

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 515293
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 7.2

Number of Means	2	3
Critical Range	815.8	855.1

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WIDTH
A	7081.0	6	4
A			
A	7046.0	6	6
A			
A	6342.4	12	10

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 515293
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 9

Number of Means	2
Critical Range	729.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	7239.2	18	1
B	5094.3	6	2

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DXW	6	1 2 3 4 5 6
DXT	4	1 2 3 4
WXT	4	1 2 3 4

Number of observations in data set = 24

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	66447810.43	6644781.04	12.90	0.0001
Error	13	6698808.53	515292.96		
Corrected Total	23	73146618.96			

R-Square	C.V.	Root MSE	TRTM Mean
0.908419	10.70929	717.8391	6702.95833

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	37112340.33	18556170.17	36.01	0.0001
CHECK	1	711638.23	711638.23	1.38	0.2610
DXW	5	6711138.28	1342227.66	2.60	0.0763
DXT	2	21912693.58	10956346.79	21.26	0.0001
WXT	0	0.00	.	.	.

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3847434.012	1923717.006	3.73	0.0523
CHECK	1	2617594.475	2617594.475	5.08	0.0421
DXW	2	2834227.519	1417113.759	2.75	0.1009
DXT	1	3219708.008	3219708.008	6.25	0.0266
WXT	0	0.000	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 515293
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 3.6

Number of Means	2	3	4	5	6
Critical Range	1154	1209	1247	1267	1282

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	DXW
	A	7522.7	3	1
	A			
	A	7292.7	3	5
	A			
B	A	6799.3	3	2
B	A			
B	A	6721.0	6	3
B	A			
B	A	6639.3	3	4
B				
B		5963.8	6	6

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 515293
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 4.5

Number of Means	2	3	4
Critical Range	1032	1082	1115

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DXT
A	7306.9	9	1
A			
A	7171.4	9	3
B	5843.3	3	2
C	4345.3	3	4

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 515293

Number of Means	2	3	4
Critical Range	893.7	936.7	965.8

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WXT
A	7590.5	6	3
A			
A	7081.0	6	1
A			
A	7046.0	6	2

Urea Placement Experiment - PRONG-UREA SITE - YIELD w/o CHECK
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DEPTH	2	2 6
WIDTH	3	4 6 10
TIME	2	1 2

Number of observations in data set = 24

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	63830215.96	7092246.22	10.66	0.0001
Error	14	9316403.00	665457.36		
Corrected Total	23	73146618.96			

R-Square	C.V.	Root MSE	TRTM Mean
0.872634	12.17008	815.7557	6702.95833

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	37112340.33	18556170.17	27.88	0.0001
DEPTH	1	1359932.04	1359932.04	2.04	0.1748
WIDTH	2	3123442.04	1561721.02	2.35	0.1321
DEPTH*WIDTH	2	1895455.38	947727.69	1.42	0.2735
TIME	1	18692544.08	18692544.08	28.09	0.0001
DEPTH*TIME	1	1646502.08	1646502.08	2.47	0.1380
WIDTH*TIME	0	0.00	.	.	.
DEPTH*WIDTH*TIME	0	0.00	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - YIELD (cont'd)

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	37112340.33	18556170.17	27.88	0.0001
DEPTH	1	1359932.04	1359932.04	2.04	0.1748
WIDTH	2	1114591.00	557295.50	0.84	0.4534
DEPTH*WIDTH	2	1453330.11	726665.06	1.09	0.3625
TIME	1	18692544.08	18692544.08	28.09	0.0001
DEPTH*TIME	1	1646502.08	1646502.08	2.47	0.1380
WIDTH*TIME	0	0.00	.	.	.
DEPTH*WIDTH*TIME	0	0.00	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 14 MSE= 665457.4

Number of Means	2	3
Critical Range	717.9	754.2

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	8382.4	8	3
B	6315.1	8	2
C	5411.4	8	1

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 14 MSE= 665457.4

Number of Means	2
Critical Range	586.1

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DEPTH
A	6941.0	12	2
A			
A	6464.9	12	6

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 14 MSE= 665457.4
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 7.2

Number of Means	2	3
Critical Range	756.7	795.0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WIDTH
A	7081.0	6	4
A			
A	7046.0	6	6
A			
A	6342.4	12	10

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 14 MSE= 665457.4
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 9

Number of Means	2
Critical Range	676.8

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	7239.2	18	1
B	5094.3	6	2

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DXW	6	1 2 3 4 5 6
DXT	4	1 2 3 4
WXT	4	1 2 3 4

Number of observations in data set = 24

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	63830215.96	7092246.22	10.66	0.0001
Error	14	9316403.00	665457.36		
Corrected Total	23	73146618.96			

R-Square	C.V.	Root MSE	TRTM Mean
0.872634	12.17008	815.7557	6702.95833

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	37112340.33	18556170.17	27.88	0.0001
DXW	5	6378829.46	1275765.89	1.92	0.1551
DXT	2	20339046.17	10169523.08	15.28	0.0003
WXT	0	0.00	.	.	.

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	37112340.33	18556170.17	27.88	0.0001
DXW	2	1453330.11	726665.06	1.09	0.3625
DXT	1	1646502.08	1646502.08	2.47	0.1380
WXT	0	0.00	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 14 MSE= 665457.4
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 3.6

Number of Means	2	3	4	5	6
Critical Range	1070	1124	1157	1176	1190

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	DXW
	A	7522.7	3	1
	A			
	A	7292.7	3	5
	A			
B	A	6799.3	3	2
B	A			
B	A	6721.0	6	3
B	A			
B	A	6639.3	3	4
B				
B		5963.8	6	6

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 14 MSE= 665457.4
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 4.5

Number of Means	2	3	4
Critical Range	957	1006	1035

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DXT
A	7306.9	9	1
A			
A	7171.4	9	3
B	5843.3	3	2
C	4345.3	3	4

Urea Placement Experiment - PRONG-UREA SITE - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 14 MSE= 665457.4

Number of Means	2	3	4
Critical Range	828.9	870.9	896.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WXT
A	7590.5	6	3
A			
A	7081.0	6	1
A			
A	7046.0	6	2
B	5094.3	6	4

Urea Placement Experiment - Width-Depth Analysis - YIELD
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DEPTH	2	2 6
WIDTH	3	4 6 10

Number of observations in data set = 18

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	25406737.76	3175842.22	9.13	0.0016
Error	9	3129994.74	347777.19		
Corrected Total	17	28536732.50			

R-Square	C.V.	Root MSE	TRTM Mean
0.890317	8.146330	589.7264	7239.16667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	22557033.33	11278516.67	32.43	0.0001
CHECK	1	57900.14	57900.14	0.17	0.6928
DEPTH	1	61724.85	61724.85	0.18	0.6834
WIDTH	2	1077677.19	538838.59	1.55	0.2641
DEPTH*WIDTH	2	1652402.24	826201.12	2.38	0.1484

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3601017.987	1800508.994	5.18	0.0319
CHECK	1	199229.928	199229.928	0.57	0.4685
DEPTH	1	78292.153	78292.153	0.23	0.6465
WIDTH	2	1077677.189	538838.594	1.55	0.2641
DEPTH*WIDTH	2	1652402.243	826201.122	2.38	0.1484

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 9 MSE= 347777.2

Number of Means	2	3
Critical Range	769.0	803.2

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	8729.2	6	3
B	6957.5	6	2
C	6030.8	6	1

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 9 MSE= 347777.2

Number of Means	2
Critical Range	627.9

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DEPTH
A	7306.9	9	2
A			
A	7171.4	9	6

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 9 MSE= 347777.2

Number of Means	2	3
Critical Range	769.0	803.2

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WIDTH
A	7590.5	6	10
A			
A	7081.0	6	4
A			
A	7046.0	6	6

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DXW	6	1 2 3 4 5 6

Number of observations in data set = 18

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	25207507.83	3601072.55	10.82	0.0006
Error	10	3329224.67	332922.47		
Corrected Total	17	28536732.50			

R-Square	C.V.	Root MSE	TRTM Mean
0.883335	7.970452	576.9943	7239.16667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	22557033.33	11278516.67	33.88	0.0001
DXW	5	2650474.50	530094.90	1.59	0.2482

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	22557033.33	11278516.67	33.88	0.0001
DXW	5	2650474.50	530094.90	1.59	0.2482

Urea Placement Experiment - Width-Depth Analysis
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 10 MSE= 332922.5

Number of Means	2	3	4	5	6
Critical Range	1048	1096	1127	1142	1153

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DXW
A	7598.7	3	3
A			
A	7582.3	3	6
A			
A	7522.7	3	1
A			
A	7292.7	3	5
A			
A	6799.3	3	2
A			
A	6639.3	3	4

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DEPTH	2	2 6
WIDTH	3	4 6 10

Number of observations in data set = 18

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	25406737.76	3175842.22	9.13	0.0016
Error	9	3129994.74	347777.19		
Corrected Total	17	28536732.50			

R-Square	C.V.	Root MSE	TRTM Mean
0.890317	8.146330	589.7264	7239.16667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	22557033.33	11278516.67	32.43	0.0001
CHECK	1	57900.14	57900.14	0.17	0.6928
DEPTH	1	61724.85	61724.85	0.18	0.6834
WIDTH	2	1077677.19	538838.59	1.55	0.2641
DEPTH*WIDTH	2	1652402.24	826201.12	2.38	0.1484

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3601017.987	1800508.994	5.18	0.0319
CHECK	1	199229.928	199229.928	0.57	0.4685
DEPTH	1	78292.153	78292.153	0.23	0.6465
WIDTH	2	1077677.189	538838.594	1.55	0.2641
DEPTH*WIDTH	2	1652402.243	826201.122	2.38	0.1484

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 9 MSE= 347777.2

Number of Means	2	3
Critical Range	623.8	651.8

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	8729.2	6	3
B	6957.5	6	2
C	6030.8	6	1

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 9 MSE= 347777.2

Number of Means	2
Critical Range	509.3

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DEPTH
A	7306.9	9	2
A			
A	7171.4	9	6

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 9 MSE= 347777.2

Number of Means	2	3
Critical Range	623.8	651.8

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WIDTH
A	7590.5	6	10
A			
A	7081.0	6	4
A			
A	7046.0	6	6

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DXW	6	1 2 3 4 5 6

Number of observations in data set = 18

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	25207507.83	3601072.55	10.82	0.0006
Error	10	3329224.67	332922.47		
Corrected Total	17	28536732.50			

R-Square	C.V.	Root MSE	TRTM Mean
0.883335	7.970452	576.9943	7239.16667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	22557033.33	11278516.67	33.88	0.0001
DXW	5	2650474.50	530094.90	1.59	0.2482

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	22557033.33	11278516.67	33.88	0.0001
DXW	5	2650474.50	530094.90	1.59	0.2482

Urea Placement Experiment - Depth-Width Analysis - YIELD
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 10 MSE= 332922.5

Number of Means	2	3	4	5	6
Critical Range	853.3	893.1	915.2	928.4	936.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DXW
A	7598.7	3	3
A			
A	7582.3	3	6
A			
B A	7522.7	3	1
B A			
B A	7292.7	3	5
B A			
B A	6799.3	3	2
B			
B	6639.3	3	4

Urea Placement Experiment - PROMG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DEPTH	2	2 6
WIDTH	3	4 6 10
TIME	2	1 2

Number of observations in data set = 24

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	27226.35224	2722.63522	2.99	0.0338
Error	13	11827.60609	909.81585		
Corrected Total	23	39053.95833			

R-Square	C.V.	Root MSE	TRTM Mean
0.697147	39.06723	30.16315	77.2083333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	16070.33333	8035.16667	8.83	0.0038
CHECK	1	2540.25519	2540.25519	2.79	0.1186
DEPTH	1	280.14077	280.14077	0.31	0.5884
WIDTH	2	3284.99506	1642.49753	1.81	0.2033
DEPTH*WIDTH	2	2516.02977	1258.01489	1.38	0.2855
TIME	1	2267.11640	2267.11640	2.49	0.1385
DEPTH*TIME	1	267.48172	267.48172	0.29	0.5968
WIDTH*TIME	0	0.00000	.	.	.
DEPTH*WIDTH*TIME	0	0.00000	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	213.366572	106.683286	0.12	0.8903
CHECK	1	1888.727240	1888.727240	2.08	0.1733
DEPTH	1	264.930355	264.930355	0.29	0.5986
WIDTH	2	526.304090	263.152045	0.29	0.7535
DEPTH*WIDTH	2	2588.211340	1294.105670	1.42	0.2763
TIME	1	2267.116398	2267.116398	2.49	0.1385
DEPTH*TIME	1	267.481724	267.481724	0.29	0.5968
WIDTH*TIME	0	0.000000	.	.	.
DEPTH*WIDTH*TIME	0	0.000000	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 13 MSE= 909.8159

Number of Means	2	3
Critical Range	26.69	28.02

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	113.62	8	3
B	62.13	8	2
B			
B	55.88	8	1

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 13 MSE= 909.8159

Number of Means	2
Critical Range	21.79

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DEPTH
A	81.83	12	6
A			
A	72.58	12	2

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 13 MSE= 909.8159
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 7.2

Number of Means	2	3
Critical Range	28.13	29.54

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WIDTH
A	90.17	6	6
A			
A	87.17	6	4
A			
A	65.75	12	10

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 13 MSE= 909.8159
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 9

Number of Means	2
Critical Range	25.16

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	85.39	18	1
B	52.67	6	2

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
DXW	6	1 2 3 4 5 6
DXT	4	1 2 3 4
WXT	4	1 2 3 4

Number of observations in data set = 24

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	27226.35224	2722.63522	2.99	0.0338
Error	13	11827.60609	909.81585		
Corrected Total	23	39053.95833			

R-Square	C.V.	Root MSE	TRTM Mean
0.697147	39.06723	30.16315	77.2083333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	16070.33333	8035.16667	8.83	0.0038
CHECK	1	2540.25519	2540.25519	2.79	0.1186
DXW	5	6081.16560	1216.23312	1.34	0.3093
DXT	2	2534.59812	1267.29906	1.39	0.2831
WXT	0	0.00000	.	.	.

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	213.366572	106.683286	0.12	0.8903
CHECK	1	1888.727240	1888.727240	2.08	0.1733
DXW	2	2588.211340	1294.105670	1.42	0.2763
DXT	1	267.481724	267.481724	0.29	0.5968
WXT	0	0.000000	.	.	.

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 13 MSE= 909.8159
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 3.6

Number of Means	2	3	4	5	6
Critical Range	39.78	41.77	42.96	43.64	44.15

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	DXW
	A	105.00	3	5
	A			
B	A	101.33	3	4
B	A			
B	A	75.33	3	2
B	A			
B	A	73.00	3	1
B	A			
B	A	71.00	6	3
B				
B		60.50	6	6

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 13 MSE= 909.8159
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 4.5

Number of Means	2	3	4
Critical Range	35.58	37.36	38.42

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DXT
A	90.00	9	3
A			
B A	80.78	9	1
B A			
B A	57.33	3	4
B			
B	48.00	3	2

Urea Placement Experiment - PRONG-UREA SITE - 6 LEAF BIOMASS
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.1 df= 13 MSE= 909.8159

Number of Means	2	3	4
Critical Range	30.82	32.35	33.27

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	WXT
A	90.17	6	2
A			
A	87.17	6	1
A			
B A	78.83	6	3
B			
B	52.67	6	4

APPENDIX IV

ALBIN SITE - 1989

28% Liquid N vs Urea Applicator

Measurements and Statistical Analysis

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	2	1 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 24

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	9055436.423	905543.642	2.32	0.0779
Error	13	5063501.411	389500.109		
Corrected Total	23	14118937.833			

R-Square	C.V.	Root MSE	TRTM Mean
0.641368	11.04682	624.0994	5649.58333

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	3319219.083	1659609.542	4.26	0.0378
CHECK	1	2993712.502	2993712.502	7.69	0.0158
FERT	1	455827.052	455827.052	1.17	0.2990
DOSE	1	905141.811	905141.811	2.32	0.1514
FERT*DOSE	1	147585.621	147585.621	0.38	0.5488
TIME	1	1127002.501	1127002.501	2.89	0.1127
FERT*TIME	1	75321.143	75321.143	0.19	0.6673
DOSE*TIME	1	2143.808	2143.808	0.01	0.9420
FERT*DOSE*TIME	1	29482.901	29482.901	0.08	0.7875

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	22758.455	11379.227	0.03	0.9713
CHECK	1	2304116.173	2304116.173	5.92	0.0302
FERT	1	453399.489	453399.489	1.16	0.3002
DOSE	1	800326.122	800326.122	2.05	0.1753
FERT*DOSE	1	147746.592	147746.592	0.38	0.5486
TIME	1	1127002.501	1127002.501	2.89	0.1127
FERT*TIME	1	75466.818	75466.818	0.19	0.6670
DOSE*TIME	1	2143.808	2143.808	0.01	0.9420
FERT*DOSE*TIME	1	29482.901	29482.901	0.08	0.7875

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 389500.1

Number of Means	2	3
Critical Range	672.9	705.3

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	5982.4	8	1
A			
A	5835.9	8	2
B	5130.5	8	3

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 389500.1

Number of Means	2
Critical Range	549.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	5799.2	12	1
A			
A	5500.0	12	3

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 389500.1

Number of Means 2
Critical Range 549.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	5740.4	12	2
A			
A	5558.8	12	1

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 13 MSE= 389500.1

Number of Means 2
Critical Range 549.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	5939.5	12	1
B	5359.7	12	2

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	4	1 2 5 6
FXT	4	1 2 5 6
DXT	4	1 2 3 4

Number of observations in data set = 24

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	9025953.521	1002883.725	2.76	0.0434
Error	14	5092984.312	363784.594		
Corrected Total	23	14118937.833			

R-Square	C.V.	Root MSE	TRTM Mean
0.639280	10.67593	603.1456	5649.58333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	3319219.083	1659609.542	4.56	0.0298
CHECK	1	2993712.502	2993712.502	8.23	0.0124
FXD	3	1508554.485	502851.495	1.38	0.2891
FXT	2	1202323.644	601161.822	1.65	0.2268
DXT	1	2143.808	2143.808	0.01	0.9399

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	14468.419	7234.210	0.02	0.9803
CHECK	1	2756299.938	2756299.938	7.58	0.0156
FXD	1	147746.592	147746.592	0.41	0.5342
FXT	1	75466.818	75466.818	0.21	0.6558
DXT	1	2143.808	2143.808	0.01	0.9399

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 363784.6

Number of Means	2	3	4
Critical Range	745.5	781.7	806.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	5968.8	6	2
A			
A	5629.5	6	1
A			
A	5512.0	6	6
A			
A	5488.0	6	5

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 363784.6

Number of Means	2	3	4
Critical Range	745.5	781.7	806.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXT
A	6126.2	6	1
A			
B A	5752.8	6	5
B A			
B A	5472.2	6	2
B			
B	5247.2	6	6

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm w/o CHECK

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FERT	2	1 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 24

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm w/o CHECK

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	6751320.250	750146.694	1.43	0.2663
Error	14	7367617.583	526258.399		
Corrected Total	23	14118937.833			

R-Square	C.V.	Root MSE	TRTM Mean
0.478175	12.84053	725.4367	5649.58333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	3319219.083	1659609.542	3.15	0.0740
FERT	1	537004.167	537004.167	1.02	0.3296
DOSE	1	198016.667	198016.667	0.38	0.5494
FERT*DOSE	1	149152.667	149152.667	0.28	0.6028
TIME	1	2017240.167	2017240.167	3.83	0.0705
FERT*TIME	1	33004.167	33004.167	0.06	0.8059
DOSE*TIME	1	16016.667	16016.667	0.03	0.8640
FERT*DOSE*TIME	1	481666.667	481666.667	0.92	0.3550

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989 (cont'd)

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	3319219.083	1659609.542	3.15	0.0740
FERT	1	537004.167	537004.167	1.02	0.3296
DOSE	1	198016.667	198016.667	0.38	0.5494
FERT*DOSE	1	149152.667	149152.667	0.28	0.6028
TIME	1	2017240.167	2017240.167	3.83	0.0705
FERT*TIME	1	33004.167	33004.167	0.06	0.8059
DOSE*TIME	1	16016.667	16016.667	0.03	0.8640
FERT*DOSE*TIME	1	481666.667	481666.667	0.92	0.3550

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm w/o CHECK

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 526258.4

Number of Means	2	3
Critical Range	776.5	814.3

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	5982.4	8	1
A			
B A	5835.9	8	2
B			
B	5130.5	8	3

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm w/o CHECK

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 526258.4

Number of Means	2
Critical Range	634.0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	5799.2	12	1
A			
A	5500.0	12	3

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm w/o CHECK

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 526258.4

Number of Means 2
Critical Range 634.0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	5740.4	12	2
A			
A	5558.8	12	1

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm w/o CHECK

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 526258.4

Number of Means 2
Critical Range 634.0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	5939.5	12	1
A			
A	5359.7	12	2

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions w/o CHECK

General Linear Models Procedure
Class Level Information

Class	Levels	Values
BLOCK	3	1 2 3
FXD	4	1 2 5 6
FXT	4	1 2 5 6
DXT	4	1 2 3 4

Number of observations in data set = 24

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions w/o CHECK

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	9025953.521	1002883.725	2.76	0.0434
Error	14	5092984.312	363784.594		
Corrected Total	23	14118937.833			

R-Square	C.V.	Root MSE	TRTM Mean
0.639280	10.67593	603.1456	5649.58333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
BLOCK	2	3319219.083	1659609.542	4.56	0.0298
CHECK	1	2993712.502	2993712.502	8.23	0.0124
FXD	3	1508554.485	502851.495	1.38	0.2891
FXT	2	1202323.644	601161.822	1.65	0.2268
DXT	1	2143.808	2143.808	0.01	0.9399

Source	DF	Type II SS	Mean Square	F Value	Pr > F
BLOCK	2	14468.419	7234.210	0.02	0.9803
CHECK	1	2756299.938	2756299.938	7.58	0.0156
FXD	1	147746.592	147746.592	0.41	0.5342
FXT	1	75466.818	75466.818	0.21	0.6558
DXT	1	2143.808	2143.808	0.01	0.9399

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions w/o CHECK

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 363784.6

Number of Means	2	3	4
Critical Range	745.5	781.7	806.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	5968.8	6	2
A			
A	5629.5	6	1
A			
A	5512.0	6	6
A			
A	5488.0	6	5

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions w/o CHECK

General Linear Models Procedure
Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 363784.6

Number of Means	2	3	4
Critical Range	745.5	781.7	806.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXT
A	6126.2	6	1
A			
B A	5752.8	6	5
B A			
B A	5472.2	6	2
B			
B	5247.2	6	6

Nitrogen Type Experiment - ALBIN SITE - YIELD 1989
Covariance on Trtm Interactions w/o CHECK

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 14 MSE= 363784.6

Number of Means	2	3	4
Critical Range	745.5	781.7	806.4

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DXT
A	6004.5	6	3
A			
A	5874.5	6	1
A			
A	5476.3	6	4
A			
A	5243.0	6	2

APPENDIX V

ALBIN SITE - 1989-1990

28% Liquid N vs Urea Applicator

Measurements and Statistical Analysis

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	2	1 2
BLOCK	3	1 2 3
FERT	2	1 3
DOSE	2	1 2
TIME	2	1 2

Number of observations in data set = 48

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	27755811.74	2523255.61	2.33	0.0279
Error	36	39061268.26	1085035.23		
Corrected Total	47	66817080.00			

R-Square	C.V.	Root MSE	TRTM Mean
0.415400	18.72293	1041.650	5563.50000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	1	355696.33	355696.33	0.33	0.5705
BLOCK	2	2986473.50	1493236.75	1.38	0.2655
CHECK	1	4120289.43	4120289.43	3.80	0.0592
FERT	1	4902554.84	4902554.84	4.52	0.0405
DOSE	1	12170116.76	12170116.76	11.22	0.0019
FERT*DOSE	1	1036789.46	1036789.46	0.96	0.3348
TIME	1	201714.46	201714.46	0.19	0.6689
FERT*TIME	1	871417.77	871417.77	0.80	0.3761
DOSE*TIME	1	18962.31	18962.31	0.02	0.8956
FERT*DOSE*TIME	1	1091796.87	1091796.87	1.01	0.3225

Source	DF	Type II SS	Mean Square	F Value	Pr > F
YEAR	1	151157.91	151157.91	0.14	0.7112
BLOCK	2	473072.37	236536.18	0.22	0.8052
CHECK	1	6900569.57	6900569.57	6.36	0.0162
FERT	1	4884601.96	4884601.96	4.50	0.0408
DOSE	1	12125714.57	12125714.57	11.18	0.0019
FERT*DOSE	1	1036517.55	1036517.55	0.96	0.3349
TIME	1	201714.46	201714.46	0.19	0.6689
FERT*TIME	1	871380.53	871380.53	0.80	0.3761
DOSE*TIME	1	18962.31	18962.31	0.02	0.8956
FERT*DOSE*TIME	1	1091796.87	1091796.87	1.01	0.3225

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 36 MSE= 1085035

Number of Means 2
Critical Range 609.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	YEAR
A	5649.6	24	1
A			
A	5477.4	24	2

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 36 MSE= 1085035

Number of Means 2 3
Critical Range 746.8 785.0

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	BLOCK
A	5887.1	16	1
A			
A	5523.3	16	2
A			
A	5280.1	16	3

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 36 MSE= 1085035

Number of Means 2
Critical Range 609.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FERT
A	5885.2	24	3
B	5241.8	24	1

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 36 MSE= 1085035

Number of Means 2
Critical Range 609.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DOSE
A	6008.9	24	2
B	5118.1	24	1

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 36 MSE= 1085035

Number of Means 2
Critical Range 609.7

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TIME
A	5663.5	24	1
A			
A	5463.5	24	2

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm Interactions

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	2	1 2
BLOCK	3	1 2 3
FXD	4	1 2 5 6
FXT	4	1 2 5 6
DXT	4	1 2 3 4

Number of observations in data set = 48

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm Interactions

General Linear Models Procedure

Dependent Variable: TRTM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	26664014.87	2666401.49	2.46	0.0230
Error	37	40153065.13	1085217.98		
Corrected Total	47	66817080.00			

R-Square	C.V.	Root MSE	TRTM Mean
0.399060	18.72451	1041.738	5563.50000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	1	355696.33	355696.33	0.33	0.5704
BLOCK	2	2986473.50	1493236.75	1.38	0.2652
CHECK	1	4120289.43	4120289.43	3.80	0.0590
FXD	3	18109461.06	6036487.02	5.56	0.0030
FXT	2	1073132.24	536566.12	0.49	0.6139
DXT	1	18962.31	18962.31	0.02	0.8956

Source	DF	Type II SS	Mean Square	F Value	Pr > F
YEAR	1	126687.694	126687.694	0.12	0.7345
BLOCK	2	473848.982	236924.491	0.22	0.8049
CHECK	1	6476652.785	6476652.785	5.97	0.0195
FXD	1	1036517.552	1036517.552	0.96	0.3348
FXT	1	871380.531	871380.531	0.80	0.3760
DXT	1	18962.310	18962.310	0.02	0.8956

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 37 MSE= 1085218

Number of Means	2	3	4
Critical Range	861.6	905.7	935.6

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXD
A	6185.0	12	6
A			
A	5832.8	12	2
A			
A	5585.3	12	5
B	4650.8	12	1

x

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 37 MSE= 1085218

Number of Means	2	3	4
Critical Range	861.6	905.7	935.6

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	FXT
A	5916.5	12	6
A			
A	5853.8	12	5
A			
A	5473.1	12	1
A			
A	5010.6	12	2

Nitrogen Type Experiment - ALBIN 1989-1990
Covariance on Trtm Interactions

General Linear Models Procedure

Duncan's Multiple Range Test for variable: TRTM

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 37 MSE= 1085218

Number of Means	2	3	4
Critical Range	861.6	905.7	935.6

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	DXT
A	6134.4	12	3
A			
B A	5883.4	12	4
B			
B	5192.5	12	1
B			
B	5043.7	12	2

APPENDIX VI

COEFFICIENTS FOR STATISTICAL ANALYSIS

28% Liquid N vs Urea Applicator

Urea Placement Experiment

Coefficients for Statistical Analysis

28% N vs. Urea - 1990

FDDD_T	Treatm Block	F	Fert D	Depth T	Time FxD	FxT	DxT
L 050_1	1	1	1	1	1	1	1
L 050_2	1	1	1	2	1	2	2
L 150_1	1	1	2	1	2	1	3
L 150_2	1	1	2	2	2	2	4
LC050_1	1	2	1	1	3	3	1
LC050_2	1	2	1	2	3	4	2
LC150_1	1	2	2	1	4	3	3
LC150_2	1	2	2	2	4	4	4
U 050_1	1	3	1	1	5	5	1
U 050_2	1	3	1	2	5	6	2
U 150_1	1	3	2	1	6	5	3
U 150_2	1	3	2	2	6	6	4

Coefficients for Statistical Analysis

Urea Placement experiment - 1990

All treatments

D_WW_T	Treatm Block	Depth D	Width W	Time T	DxW	DxT	WxT
2_04_p	1	2	4	1	1	1	1
2_06_p	1	2	6	1	2	1	2
2_10_p	1	2	10	1	3	1	3
2_10_s	1	2	10	2	3	2	4
6_04_p	1	6	4	1	4	3	1
6_06_p	1	6	6	1	5	3	2
6_10_p	1	6	10	1	6	3	3
6_10_s	1	6	10	2	6	4	4

Depth and Width Treatments

D_WW_T	Treatm Block	Depth D	Width W	DxW
2_04_p	1	2	4	1
2_06_p	1	2	6	2
2_10_p	1	2	10	3
6_04_p	1	6	4	4
6_06_p	1	6	6	5
6_10_p	1	6	10	6

Depth and Time Treatments

D_WW_T	Treatm Block	Depth D	Time T	DxT
2_10_p	1	2	1	1
2_10_s	1	2	2	2
6_10_p	1	6	1	3
6_10_s	1	6	2	4